AMERICAN MACHINIST

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The Ainsworth Drop Hammer.

In the accompanying illustrations, pages 1 and 2, is shown a drop hammer, which has been designed to avoid some of the difficulties attending the use of such machines as ordinarily constructed.

In this machine, instead of using a board for the friction rollers to act upon, a steel strap is used, the rollers being made of paper instead of cast-iron. By this means the required adhesion is secured, between the rollers and strap, and yet a strap is used which is practically indestructible.

When the friction rollers of a hammer of this class are brought into contact with the strap to raise the hammer, there is, of course, more or less slip between the rolls and strap, and while the wear caused by this slip is distributed evenly over the surface of the rolls, it takes place at one point only on the strap, reducing its thickness, and making a shoulder at this point, which soon causes trouble. Then when the hammer is used for some time at a short stroke, a shoulder is also formed at the point on the strap at which the rollers release it, which is apt to be troublesome when it is desired to use a longer stroke.

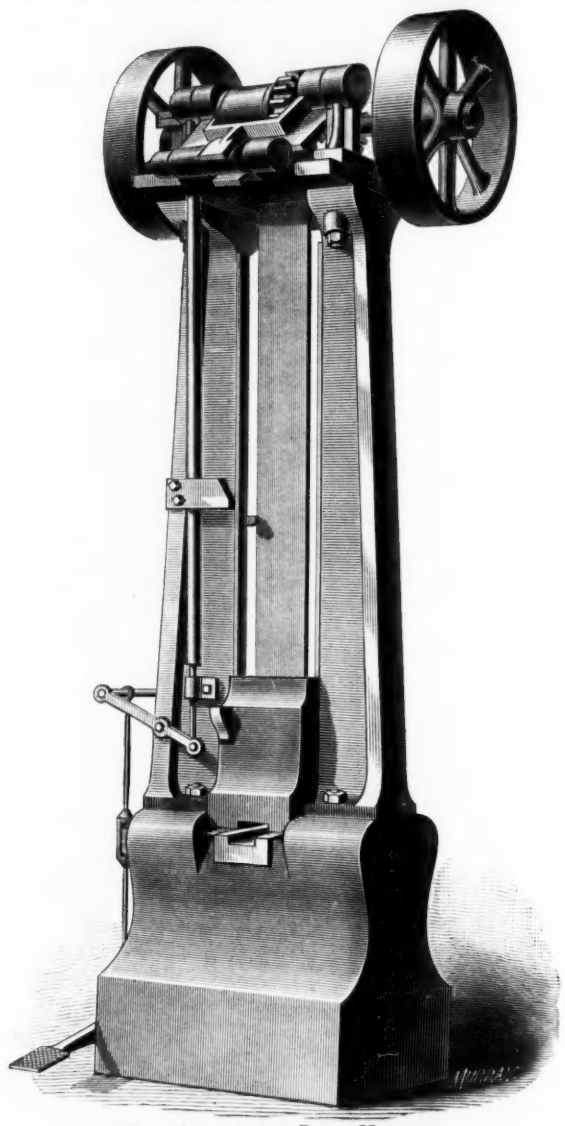
It was with the object of avoiding these difficulties that the inventor of this hammer has substituted for the board usually employed a strap of steel, on which there will of course be comparatively little wear, while that which takes place upon the roll will be evenly distributed, and consequently cause little trouble.

The steel strap is cushioned at the bottom, where it is attached to the ram, by rubber or cork, and in this hammer is a permanent part of the machine; no frequent renewals being necessary, as is the case where the strap is composed of a softer or less durable material.

The makers state that the rolls are made of a very hard and dense paper, known as "trunk board," which is similar to that used in making paper car wheels, and is very durable, showing but little wear after long use.

The character of the material, and of the adhesion secured by its use, is shown by the fact that the hammer may be dropped and caught by the rolls before reaching the anvil, without apparent injury to the surface of the rolls.

The manufacturers are Williams, White & Co., Moline, Ill.

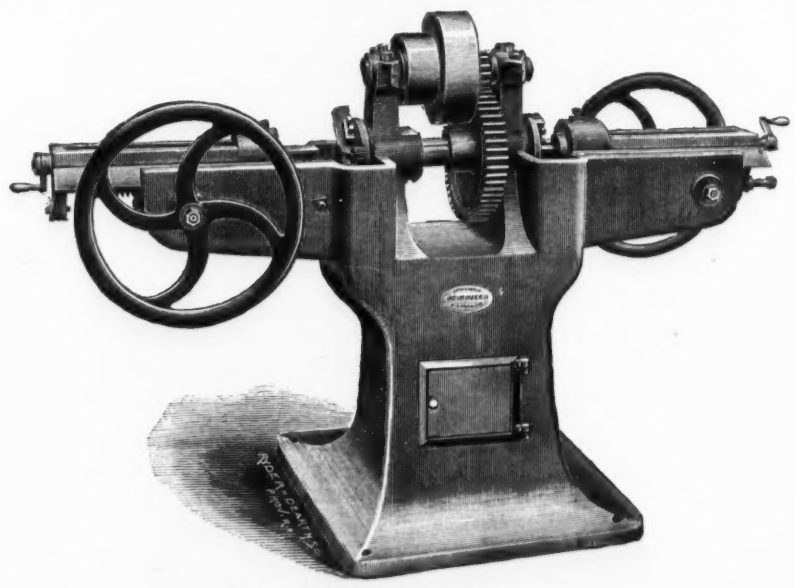


THE AINSWORTH DROP HAMMER.

New Nut and Bolt Facing Machine.

In our issue of September 24, 1887, we illustrated a new machine placed upon the market by Nicholson & Waterman, of Providence, R. I., for milling nuts and bolt heads. In this issue we illustrate the companion machine, viz., for facing or squaring up. This machine consists of a central arbor driven by gearing, as shown, at either end of which are face plates provided with grooves for receiving the cutters. One end of the machine is used and fitted for trimming off the tops of bolt heads, and the other end for the two sides of nuts. The bolt previously turned is held in a chuck, which centers it with the turned stem, and is fed against the cutters until a proper shape is secured. The nuts are screwed on to threaded arbors, thus centering on the thread, and are in a similar manner approached to the cutters. Oil or lubricant is fed upon each cutter plate, and the chips and waste are collected and held in a box, access to which is had through the door in the base.

The points of advantage claimed for this machine are that it faces true with the threading or stem of bolt, and with the milling machine previously mentioned, will reduce very materially the cost of finished nut and bolt.



NUT AND BOLT FACING MACHINE.

Compound Engines.

BY W. H. BOOTH.

I.

A compound engine, as its name implies, is one in which the acting steam is utilized in more than one cylinder. Since the introduction of triple expansion engines it has become a common error to suppose that the compound engine has two cylinders only in which the same steam is expanded, and that triple expansion, or other multi-cylinder engines, are not compound. The use of the word compound, however, belongs even more to the higher developments than to merely the ordinary best known two cylinder type.

Another but less common error is to call a pair of simple engines actuating one crank shaft only, a compound engine. This, of course, is quite a misconception, and the term compound is only applicable to engines in which the working steam successively enters two or more cylinders, in each of which it is partially expanded before passing into the next and larger cylinder.

The worst error, however, which obtains in even engineers' opinions and ideas of compound engines, is the supposition that the steam is used twice over, and therefore a double amount of work obtained from it. Why those who hold to these ideas have not extended the principle of compounding indefinitely, seeing that by so doing they might obtain an infinitely great power from very small cylinders, it is difficult to say, for surely steam which can be worked twice ought to be capable of working many times.

In studying the compound engine, it cannot be too clearly remembered that all calculations as to its power must be based simply upon the last and largest cylinder alone, for this, of course, is the measure of the power of the machine, the introduction of extra cylinders between it and the boiler being merely advantageous by reason of certain known facts and certain little understood principles which lie at the base of the practical superiority of *well-designed* compound over simple engines. As a generator of power, however, from steam of any pressure, the efficiency of the compound engine is merely equal to that of a simple engine with a cylinder having a diameter equal to that of the final cylinder of the compound engine.

I use the words *well designed* above advisedly, for a badly-designed compound engine is a contrivance especially devised to waste steam and fuel, and it is because of bad designing that the progress of compound engines has been much delayed. Even yet there are many engineers who persist in the belief that no advantage can be got by compounding. The weight of evidence is, however, against them, and many who stood out longest against the innovation have been compelled to succumb to progressive science, and in England now it is rare to find simple engines being newly put down, and the old simple engines are being rapidly removed or compounded.

In this series of articles I purpose dealing with compound engine design, by pointing out the causes of its superiority, both mechanical and physical, as well as accidental, in which category may be placed such causes as depend upon the skill and accuracy displayed in construction. And I shall endeavor to show how loss may occur from bad designs, and how the loss in simple engines from faulty construction is partially avoided by compounding. Just now, when compound engines are claiming more attention from American steam users, seems to be a fitting time to examine into the principles affecting compound working.

Of the mechanical causes which contribute to the running of compound engines, the first is the reduction of stress in the

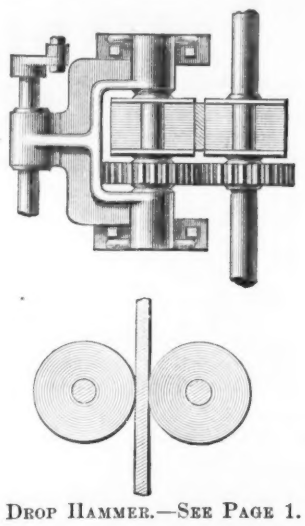
working parts, which may be effected even when both high and low pressure cylinders have one common piston-rod, and transmit their whole power through one crank-pin. Many—even engineers—who have not paid special attention to the subject, are not disposed to believe that such is the case. Let us, however, roughly calculate the question for the two principles. Assume a simple engine, with cylinder area represented, for convenience, by say 3, carrying steam of 99 pounds absolute pressure, and expanding, say 9 times. Then for a compound engine of equal power, the low pressure cylinder will have an area represented by 3, as in the simple engine, whilst the high pressure cylinder will have an area of 1. For nine expansions the cut-off will be therefore at one-third in the small cylinder, and the same in the large cylinder. Now in the simple engine the initial piston load will be $99 \times 3 = 297$.

In the compound tandem engine the small piston load will be $99 \times 1 = 99$. The initial pressure in the large cylinder is $99 \div 3 = 33$. Hence the large piston load is $33 \times 3 = 99$. Adding these two gives 198 as the total forward pressure of the compound engine. From this, however, we require to subtract the back pressure on the small piston. This is the same as the forward pressure on the large piston, or 33 Hence 33 × area of small piston $= 33 \times 1 = 33$; $198 - 33 = 165$, and this is the total load which passes as a maximum upon the crank pin, or only .55 of the simple engine load. This ratio of course will be somewhat different in actual practice, according to the back pressure and other causes, but the above calculation will be sufficient to show how very much less are the stresses on the working parts of a compound as compared with a simple engine of equal size. This, of course, does not imply that the compound engine is of less power. The reduction of the initial pressure is coincident with an extension of the initial load for a greater length of stroke. The variation of crank-pin pressure is thus less severe in the compound engine. The lower initial pressure brings into prominence certain other points in design, which depend upon weight and speed of piston, etc , and to which further consideration will be given.

Any economy directly resulting from the reduction of stresses is that due to lessened friction of the smaller bearing surfaces necessary. One of the constructive causes of economy resulting from compounding is that due to the smallness of the high pressure piston. In the simple engine of area 3, the circumference of the piston may be set down as 1, or unity. Round this circumference, steam of high pressure tends to leak, and does leak when the piston is faulty.

The circumference of a high pressure piston of one compound engine is to that of the large piston as $\sqrt{1} : \sqrt{3}$, or .58. That is to say, there is little more than one-half the leakage line in the compound engine exposed to boiler steam. Further, whilst in the simple engine there is full boiler pressure on one side of the piston, and only the condenser pressure on the other, in the compound engine the boiler pressure on one side of the small piston has opposed to it the back pressure of, in our case, 33 on the other side. We may thus fairly claim a leakage coefficient of less than half. Of course we still have the low pressure leakage, but as the low pressure piston is exposed to quite low steam, this is not serious.

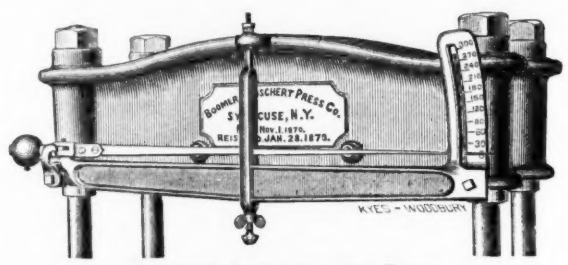
Further, in the simple engine, any steam leaking past the piston is wasted directly into the condenser, where it raises the final pressure and diminishes the power developed per pound of fuel. In the compound engine, on the contrary, such reduced leakage as there is past the first piston is intercepted by the second cylinder, before it passes to the condenser. In this way it is partially recovered, in that it raises the forward pressure in the large cylinder. This is one of the reasons why in compound engines it is usually advisable to make the small cylinder of somewhat greater diameter than theory would indicate. A further advantage which arises from the foregoing



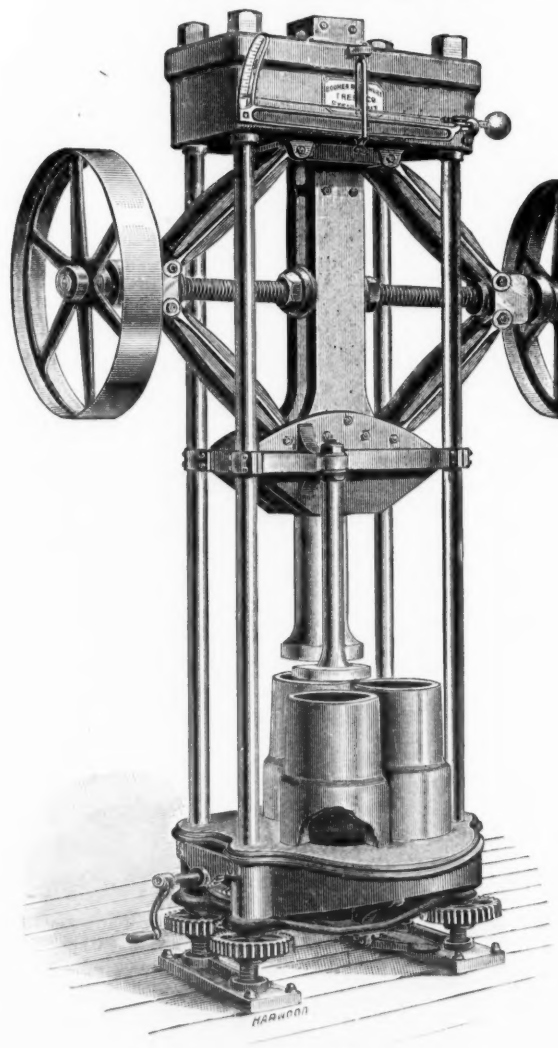
DROP HAMMER.—SEE PAGE 1.

causes is the reduction in friction which may be effected by lighter spring packing of the pistons. With the smaller pressures there is less need of severe tightening up of the packings, and therefore cylinders and packing will last longer and work better.

The remarks here made apply with equal force to valves as to pistons, for the high-pressure valve is proportunate in size to the high-pressure piston, and requires correspondingly less power to move it, as well as presenting smaller leakage surfaces. Proceeding, we come to the question of radiation, and find that whilst the large cylinder has heads of a joint area of 6, the small cylinder of the compound engine has head areas of 2 only. The bodies of the two cylinders have an area of .58 and 1.00. The radiating surfaces, which are heated up to boiler pressure, are thus very much less indeed in the compound engine, and though the large cylinder has equal surface, and the total radiating surface of the compound is much greater than that of the simple engine, the effect is less, for the hottest steam is radiating only from an area of from a third to a half.



PRESSURE INDICATOR FOR PRESS.



NEW PRESS.

New Press.

In this press the power or pressure is obtained by a combination of toggle levers, worked by a screw with right and left hand threads, drawing the levers to a perpendicular. The screw is held in equilibrium by collars bearing against the sliding standard, which is rigidly attached to the platen. If, by chance, the pressure becomes greater under one side of the platen, throwing the standard to one side, the levers on that side will cause the collar on the screw to bear against the opposite side of standard, and thus the tendency of the standard to move in one direction is equalized by the effort of the screw to move in the other.

The screw is operated by belts over pulleys on one or both ends of screw, for very rapid motion, and by chain or link belts over sprocket wheels for slower motions, or it may be worked by hand by means of ratchet and lever.

In the cut shown, there are three cylinders or hoops connected together, hung on a central plate or pin. This pin extends down through the base and rests on a lever. The operator, by pressing with his foot on the lever, raises the cylinders slightly clear of the base, when they may be easily rotated, bringing one of the cylinders under the central plunger, where the pressure is applied, while at the same time a supplemental plunger attached to the side of the platen pushes the pressed block through a hole in the base, while the third cylinder is being charged.

The speed with which the press can be run depends on the skill of the operator, the only limit being the rapidity with which the cylinder or hoop can be filled.

For dry substances the cylinders are made with a solid shell; for moist substances, of staves and bands.

The inside of cylinder may be of any desired form—as round, square, hexagon, etc. The base is adjustable, so as to vary the thickness of cake or material being pressed. In very rapid and heavy work the screw nuts are so constructed as to introduce a stream of water, to prevent heating.

The press is driven by a countershaft, operated by friction clutches, and can be so constructed as to stop the press at extreme rise and fall of platen, or so it will run down and reverse, stopping only when up.

The detached cut represents the pressure indicator used with these presses. The bar is fastened by a screw to one end of the head and supported by a bolt from the center. The opposite end receives one of the bearings of the pointer, which are hardened, and constructed with knife edges, like the bearings of steelyards or scales. The weight of the pointer is nearly counterbalanced by the ball upon the outer end. A very slight spring of the head is multiplied, so as to show a considerable movement of the pointer on the scale. The pointer is adjusted to 0, by the pointed set screw in the lower end of the center bolt. The indicator is said to be as accurate as a pair of steelyards or scales, and enables the operator to put more or less pressure upon the material in the press, as desired.

This press is manufactured by the Boomer & Boschert Press Co., Syracuse, N. Y.

Draftsman or Mechanical Engineer?

A correspondent writes us—referring to a recent editorial in the AMERICAN MACHINIST, under the heading "Causes which Lead to Accidents, and which Draftsmen Might Prevent"—suggesting that we define the difference between "draftsman" and "mechanical engineer." Possibly we might do this to our own satisfaction, but it is quite as certain that our definition would not change the opinions of others who think differently.

As the whole matter is one of opinion simply, any discussion of it would be entirely unprofitable, so far as we can see. In the editorial to which our correspondent refers we used the word draftsman because we thought it more likely to be understood. The person in charge of the drawing room of most large manufacturing establishments in this country is designated, we believe, as "head draftsman," notwithstanding his work is largely in the line of mechanical engineering, and it would be a difficult matter for any one to determine where the draftsman leaves off and the mechanical engineer begins, or vice versa.

The *Engineer* (London) says: "Several years ago a curious experiment was tried by a Leeds engineer. He took a large funnel fitted with a stop-cock, and screwed the pipe into the top of a boiler containing steam of about 40 lb. pressure. He then filled up the funnel with cold water and opened the stop-cock. It would naturally have been predicted that the steam would have blown all the water out of the funnel. It did nothing of the kind. On the contrary, the water rushed into the boiler. As a result of this and several other experiments, a boiler feeder was designed and patented, and worked with tolerable success. It was found, however, that it was not certain in its action; and the injector coming into high favor at the time, the inventor spent no more money on his ingenious idea. The inrush of the water was due to the fact that the steam condensed in the long pipe of the funnel, and "water hammer" action then drove the water into the boiler. Practically just below the cold water there was always a vacuum into which the water was driven by its own weight and the pressure of the air."

A special car, built for transporting the heavy machinery imported from England by the Bethlehem Iron Company, has a carrying capacity of 100 tons.

Practical Drawing.

BY J. G. A. MEYER.

FORTY FOURTH PAPER.

Problem 57.

405. CUTTING PLANES: TO FIND THE PROJECTIONS OF GIVEN POINTS IN A CYLINDRICAL SURFACE; ALSO THE POINTS IN WHICH A GIVEN LINE WILL PIERCE A CYLINDRICAL SURFACE.

Fig 290, let $i_3\ j_3\ k_3\ l_3$ represent a vertical projection of a cylinder with circular base, and $m_3\ n_3$ its axis. Assume that through this cylinder is passed, at a given distance from its axis, and parallel to the same, a cutting plane $a_3\ b_3$, perpendicular to the vertical plane of projection. Since, in this view, the cutting plane is seen standing perpendicular to the vertical plane of projection, we can only see, so to speak, the edge of the cutting plane, and therefore it must, in this projection, be represented simply by the line $a_3\ b_3$; or, more strictly speaking, the cutting plane must be represented by its trace $a_3\ b_3$ (Arts. 229, 246); and, because the cutting plane is parallel to the axis, its trace $a_3\ b_3$ must also be parallel to the axis $m_3\ n_3$. Let us now remove the part $a_3\ b_3\ k_3\ l_3$, which has been separated by the plane $a_3\ b_3$ and then find the horizontal and vertical projection, such as are shown in Figs. 292 and 291 of the remaining part $i_3\ j_3\ a_3\ b_3$ of the cylinder.

In these two projections (Figs. 291 and 292), the part $i_3\ j_3\ a_3\ b_3$ of the cylinder is to be represented as standing with the cutting plane parallel to the vertical plane of projection.

Draw the ground line *A B*. At a convenient distance below, and parallel to the ground line, draw a line $e_2\ g_2$ (Fig. 292); from a point m_2 as a center on the line $e_2\ g_2$ describe a circle $a_2\ i_2\ c_2$ whose diameter $e_2\ g_2$ is equal to the line $i_3\ k_3$. Through the center m_2 draw the vertical line $o_2\ i_2\ m$; on this line, below the center m_2, lay off a point o_2; the distance between the center m_2 and the point o_2 must be equal to that between m_3 and a_3 in Fig. 290.

Now, because the cutting plane is to be parallel to the vertical plane of projection, draw through the point o_2 a line $a_2\ c_2$ parallel to the ground line *A B*, cutting the circumference $a_2\ i_2\ c_2$ in the points a_2 and c_2. The line $a_2\ c_2$ represents the horizontal trace of the cutting plane, and the points a_2 and c_2 represent points in the elements in which the cutting plane intersects the cylindrical surface. Draw the vertical projection $e\ f\ g\ h$ of the cylinder (Art. 301) as shown in Fig. 291. Through the points a_2 and c_2 draw the vertical lines $a_2\ a$ and $c_2\ c$, cutting the bases $e\ g$ and $f\ h$ in the points a_1, b and c_1, d; the line $a\ b$ will be the vertical projection of the element which is represented by the point a_2 in Fig. 292; the line $c\ d$ will be the vertical projection of element which is represented in Fig. 292 by the point c_2. The lines $a\ b$ and $c\ d$ represent those elements in which the cutting plane intersects the cylindrical surface. It may also be remarked that the line $a\ b$ (Fig. 291) and the line $a_3\ b_3$ (Fig. 290) represent one and the same element, and the line $c\ d$ represents an element which in Fig. 290 coincides with, or is hidden by, the line $a_3\ b_3$.

According to Art. 294, the cylindrical surface, shown in Fig. 290, can be generated by the rectangle $m_3\ n_3\ k_3\ l_3$, turning around its side $m_3\ n_3$; this side will be the axis of the cylinder, and the line $k_3\ l_3$ will generate the cylindrical surface. Again, according to Art. 298, a line in the cylindrical surface, coinciding with the side $k_3\ l_3$ of the generating rectangle, will be an element of the cylindrical surface. Since in the rectangle $m_3\ n_3\ k_3\ l_3$, the side $k_3\ l_3$ is always parallel to the side $m_3\ n_3$, it follows that the elements of the cylindrical surface are parallel to the axis. If we now consider this rectangle to be a cutting plane, then the line in which it intersects the cylindrical surface must be an element, and consequently the line of intersection must be a straight line parallel to the axis.

Again, Fig. 292, let the line $m_2\ c_2$ represent the trace of the rectangle, and considering it to be a cutting plane, we find that in this position it will cut the cylindrical surface in an element which is represented by the point c_2, its horizontal projection. Now, assume the rectangle to be turned around the axis m_2 until it occupies the position represented by the trace $m_2\ a_2$; in this position it will cut the cylindrical surface in the element a_2. But through the elements represented by the points a_2 and c_2 we can pass a cutting plane represented by the trace $a_2\ c_2$; this plane, of course, will be perpendicular to the horizontal plane of projection, and because these elements are parallel to the axis, the plane $a_2\ c_2$ must also be parallel to the axis. Therefore we conclude that all cutting planes which are parallel to the axis—and whether these cutting planes do or do not pass through the axis makes no difference—will always intersect the cylindrical surface in two elements, that is to say, the cutting planes parallel to the axis will always intersect the cylindrical surface in straight lines parallel to the axis of the cylinder. This principle, although very simple, is an important one, and should be remembered, because, as will hereafter be seen, that often, for the purpose of locating points or finding the projections of points we employ these cutting planes; thus, for instance:

406. Let $e\ f\ g\ h$ (Fig. 293) be the vertical, and $i_2\ j_2\ k_2\ l_2$ (Fig. 294) the horizontal projection of a cylinder standing in an oblique position, with its axis parallel to the vertical plane of projection. Let the point p represent the vertical projection of a given point in the cylindrical surface, and *A B* the ground line; it is required to find the horizontal projection of the same given point.

According to Art. 227, the vertical and horizontal projections of a given point must lie in a line drawn perpendicular to the ground line *A B*, hence through the point p draw a vertical line $p\ p_2$, and now, in order to determine the position of the point p_2—that is, the horizontal projection of the given point—in this line, we proceed as follows:

Assume the projecting plane of the upper base of the cylinder to be turned around its trace $g\ e$ until it coincides with the plane of the paper; in turning this plane around its trace all the points in the plane will move in paths represented by lines drawn parallel to the axis $n\ m$. Hence, prolong the line $n\ m$ towards k_3; on this line lay off a point m_3; the distance between m and m_3 must be equal to the distance between the ground line *A B* and the center m_3, in Fig. 294. From the point m_3 as a center, and with a radius equal to $m\ e$, describe the circle $e_3\ i_3\ g_3\ k_3$; through m_3 draw a line $e_3\ g_3$ perpendicular to $n\ k$. Through the point p assume a cutting plane to be passed, parallel to the axis $n\ m$, and perpendicular to the vertical plane of projection; hence through the point p draw a line $b\ a_3$ parallel to $n\ k_3$; the line $b\ a_3$ will represent the trace of the cutting plane, and this plane intersects the cylindrical surface in the element $b\ a$, which contains the point p. In Fig. 295 we see that the cutting plane intersects the circumference $e_3\ i_3\ g_3\ k_3$ in the points a_3 and c_3; the point a_3 represents the extremity a of the element $a\ b$; the point c_3 represents the extremity of the element coinciding with, and hidden by, the element $a\ b$. Through a draw the vertical $a\ a_2$, cutting the ground line *A B* in the point t; from t, on the line $a\ a_2$, lay off a point a_2; the distance between the points t and a_2 must be equal to that between the points a and a_3. If the drawing has been correctly made, the point a_2 will lie in the ellipse, as it should do. The points a, a_2, a_3 represent the same extremity of the element $a\ b$. Through a_2 draw a line $a_2\ b_2$ parallel to *A B* and cutting the line $p\ p_2$ in the point p_2; this point p_2 will be the horizontal projection—which was to be found—of the given point in the cylindrical surface.

The line $a_2\ b_2$ is the horizontal projection of the element represented by the line $a\ b$, and therefore the horizontal projection p_2 of the given line must be in the line $a_2\ b_2$, and since the point p_2 must also lie in the vertical $p\ p_2$, it follows that the point in which the lines $p\ p_2$ and $a_2\ b_2$ intersect each other must be the point sought.

408. *Draftsman's Method.*—Since on working drawings the ground line *A B* is not shown, and in order to save time the draftsman simply draws the vertical line $p\ p_2$, cutting the center line $f_3\ g_3$ in the point u; then on the line $p\ p_2$ from the point u he lays off a point p_2, the distance between the point u and p_2 is made equal to that between the points r_3 and a_3. This construction, as will be perceived, is based on the same principle previously explained.

409. Take another example: Figs. 296, 297. Let $a\ b\ c\ d$ represent the vertical, and $a_2\ c_2\ f_2\ h_2$ the horizontal projection of a cylinder; $j\ k$ and $j_2\ k_2$ the projections of a given line passing through this cylinder; it is required to find the points in which the given line will pierce the cylindrical surface.

When we remember that the horizontal and vertical projections of a point must lie in a line drawn perpendicular to the ground line (Art. 227), the solution of this problem becomes very simple. In Fig. 297 it is plainly seen that the line $j_2\ k_2$ pierces the cylindrical surface in the points m_2 and l_2. The vertical projections of these points must lie in the line $j\ k$ (Fig. 296), and also in the vertical lines drawn through the points m_2 l_2. Therefore through the points m_2 and l_2 draw the vertical lines $l_2\ l_3$ and $m_2\ m_3$ cutting the line $j\ k$ in the points l and m; these points will be the vertical projections of the points in which the given line pierces the cylindrical surface.

The correctness of this solution can also be proved by assuming a cutting plane perpendicular to the horizontal plane of projection to be passed through the line $j_2\ k_2$. This cutting plane intersects the cylindrical surface in two elements containing the points in which the given line pierces the surface. These elements are represented in Fig. 296 by the lines $l_3\ l_4$ and $m_3\ m_4$, and can be obtained by drawing through the points l_2 and m_2 vertical lines cutting the bases in the points l_3, l_4 and m_3, m_4. Now, since the cutting plane contains these elements, and also the given line, it follows that the points l and m, in which the line $j\ k$ intersects the elements, must be the vertical projections of the points in which the given line pierces the cylindrical surface.

The part of the line $j\ k$ lying between the points l and m (Fig. 296), and also that between l_2 and m_2 (Fig. 297, must be dotted, because this part of the given line is hidden.

Directions.—In the space marked 57 draw the vertical and horizontal projections of a cylinder 8 inches in diameter and 10 inches high. The axis of the cylinder is to be parallel to the vertical plane of projection. Use a three-inch scale. In the vertical projection draw a line $j\ k$, making any angle except a right angle with the element $a\ b$. In the horizontal projection draw a line $j_2\ k_2$, making any angle, except a right angle, with the center line $a_2\ c_2$. Assume the lines $j\ k$ and $j_2\ k_2$ to be the vertical and horizontal projections of a given line, then find the points in which this line will pierce the cylindrical surface. After these points have been found, determine the correct length of that part of the given line which lies between the points $(l\ l)$ and $(m\ m_2)$, or in other words find the correct distance between the points in which the given line pierces the surface.

When the projections $j\ k$ and $j_2\ k_2$ of a given line are oblique lines, as shown in Figs. 296 and 297, the correct length of the given line cannot be seen (Art. 241).

Consequently, to find the correct length of that part of the line which lies inside the cylindrical surface, we must use one of the methods given in Problem 40. This construction should also be drawn in space 56.

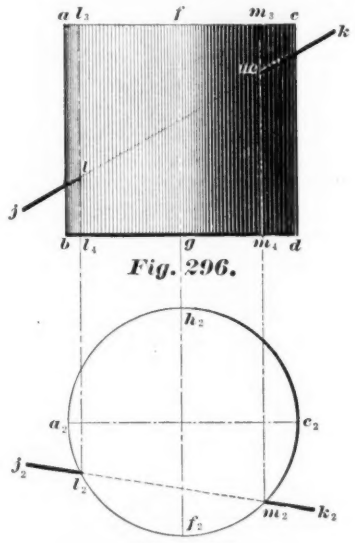


Fig. 296.

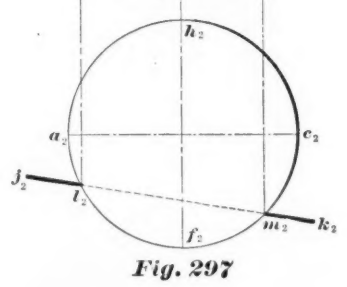


Fig. 297

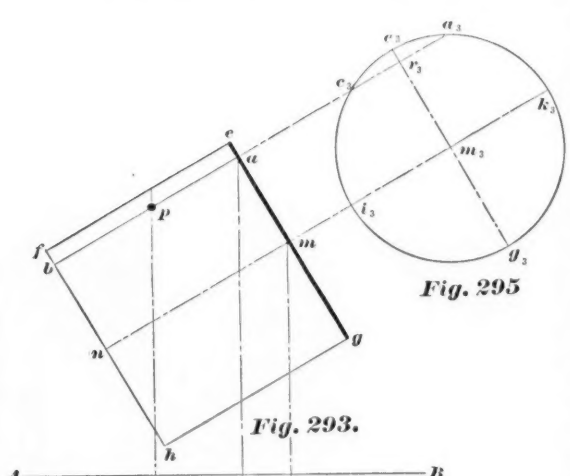


Fig. 295

Fig. 293.

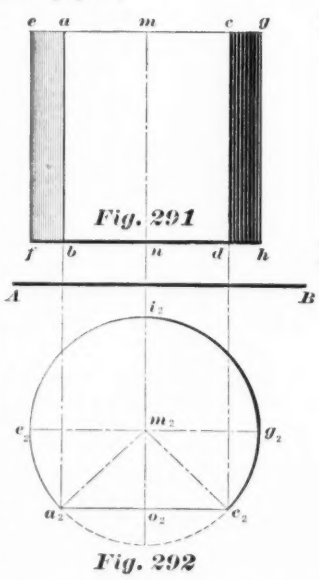


Fig. 291

Fig. 292

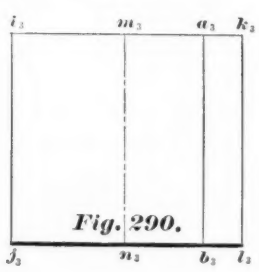


Fig. 290.

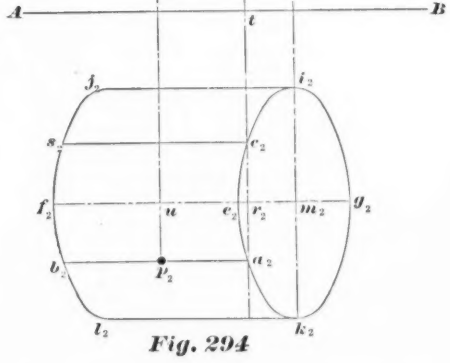


Fig. 294

We believe it would be entirely within bounds to say that several times more lives are lost in New York by elevator accidents than by boiler explosions. Why this is so is an interesting subject for inquiry.

Roll-Over Flask Clamp.

The cuts, Figs. 1 and 2, show a flask clamp for moulders, which is quite simple in construction, and can be very easily and quickly applied and removed.

The short lever at the back, Fig. 2, is attached to a short section of a double-threaded screw, the threads of which engage with the teeth shown on the back of the sliding piece, so that, when the screw is turned one way or the other, it tightens or loosens the clamp.

To enable the clamp to be quickly set to suit any size flask, the threads on one side of the screw are cut off, so that when this part of the screw is brought next the sliding piece it can be slipped freely in or out to any desired length, when a part turn of the lever brings the teeth into engagement and locks the clamp.

The maker states that no fitting is required on the clamp, all the parts being cast to go together. The maker is J. W. Dennis, Buffalo, N. Y.

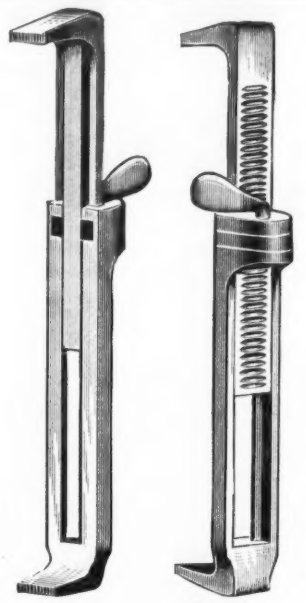


FIG. 1. FIG. 2.

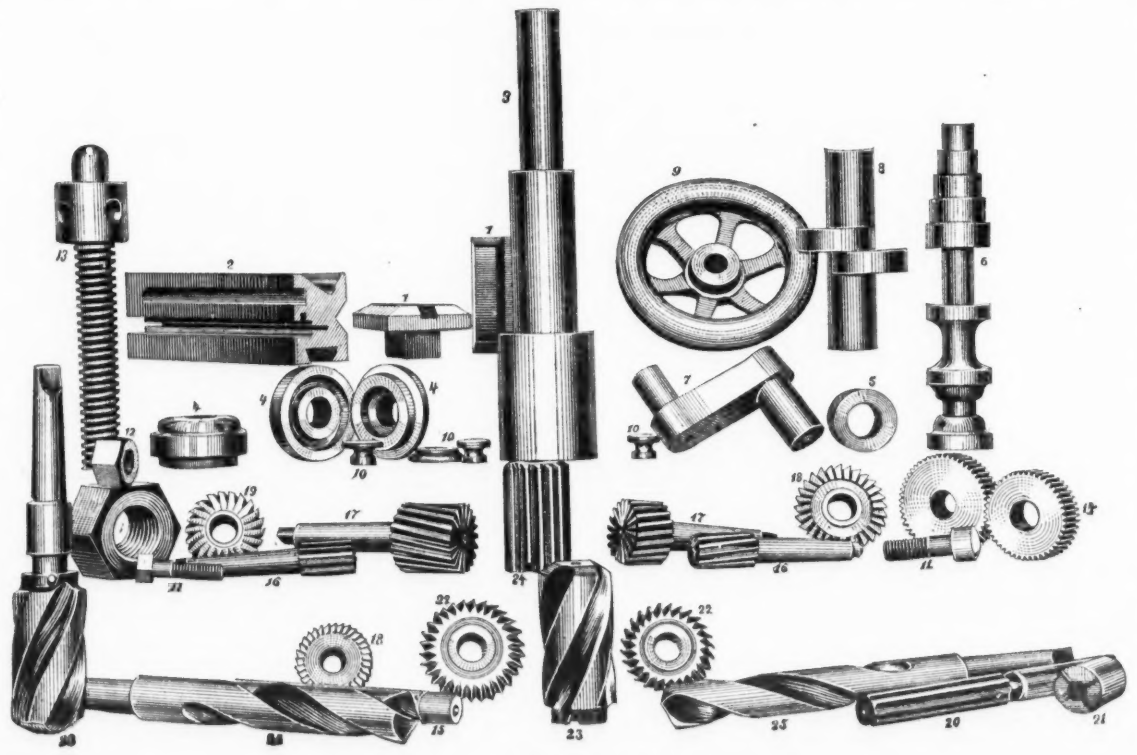
FLASK CLAMP.

Elementary Practice in Iron and Steel Working at Sibley College, Cornell University, Ithaca, N. Y.

It is a fact quite beyond question that the subject of manual training—and by manual training we mean the kind of education that fits men to do something with their hands—is considered of the first importance by those interested in the education of the young men of the country. The feeling in this respect has been intensified by efforts in the same direction in England and Germany, and to such an extent is this true that this kind of education is very generally being introduced into the common school system of the country. While it may be true that in our public schools something in the way of a foundation for manual training may be laid, it must be apparent that little more than this can be done. To attempt this to anything like the extent which over-sanguine people seem to believe possible, would be a manifest damage to our common school system, which the mass of the people will, very properly, resent. These schools are established for quite another purpose, and educational efforts in them should be in a general, rather than in a specific direction.

But there is abundant opportunity for manual training in our excellent technical schools, and those who control these schools are showing an intention to place them in accord with the popular will in this respect, by imparting instruction in the direct line of practice. In these schools it has, very properly we think, come to be considered that education, apart from its practical industrial value, is of secondary importance; in other words, that education, in the popular sense of the word, must go hand in hand with practice; that education that aims to show why certain results will obtain should be wedded to education that shows in some degree how to obtain these results. The course of our technical schools in regard to this cannot fail to commend itself to every one, and it should be a matter of congratulation that these schools have been placed in the front rank, as compared with any similar schools in the world. Theory and practice, when properly yoked, go hand in hand, and this is more fully appreciated to-day than ever before.

As typifying, in some degree, the work done in our technical schools, we have been favored with an outline of the introductory work of the Sibley College of Cornell University, pursued there in the iron working shops, as preparatory to the advanced work of design and construction of the various kinds of machinery designed and built by the upper classmen. This is the "manual training course." A group of the exercises of this course, selected as typical examples, has been arranged and photographed for us by Mr. Anderson, the foreman of the shops, and is sent us by Prof. Morris, the Professor of the Mechanic Arts, through the director, Dr. Thurston. This group we have reproduced, and show in the accompanying engraving.



IRON AND STEEL WORKING AT SIBLEY COLLEGE.

Taking up the exercises one by one, in the order of the numbers attached, we can follow the course of instruction for the first part (nearly half) of the course.

No. 1 is an exercise in chipping, filing and finishing. This block, rough from the foundry of the college, and from the hands of the students in that department, comes to the new hand in the machine shops with no other preparation than the removal of the sand adhering to it on its withdrawal from the flask in which it was cast. The edges must be chipped straight and even, and very smooth; the corners must be sharp, and exactly square; the surfaces must be made even and plane with the chisel and straight-edge; and the final finish, which is only given on alternate sides, must be as perfect as draw-filing and patience can make them. Failing at the first attempt, the student must try again and again, if necessary; and he is not allowed to take up No 2 until No. 1 has passed inspection by the senior instructor.

No. 2 is a planer exercise, in which the surfaces of a casting about $8'' \times 3'' \times 2\frac{1}{2}''$ are planed square, grooved as shown, and brought exactly to scale and dimensions, as indicated by the drawing with which the student is furnished. The drawings are made by members of the "Freshman" class, and blue-printed by them for use in all the shops, from the elementary wood-working to the final construction of lathes, engines and other machinery.

No. 3 is a lathe exercise in heavy cutting, and turning to gauge from the drawing, and with the help of the standard gauges, of which a full line are in the storeroom, some purchased and many made in the shops by the students themselves. In Nos. 4 and 5 the last exercise is cut into several parts, and finished, as shown, thus giving practice in boring, fitting, cutting-off, etc., etc. These pieces, as in No. 4, are required to be so well fitted that no shake of the one in the other can be detected, yet be so easy in fit that only the air pressure resists their separation. No. 6 is an exercise intended to give good practice in calipering. Certain parts are turned to size, a specified variation being allowed; other parts are expected to be made absolute fits; still other sections must be given the exact form and size shown in the drawing, as measured by the standard gauges, and filleted, worked to a shoulder, etc., etc., until the whole piece takes the shape and sizes seen. This piece is used later in the production of still other work. No pieces are lost; every part and piece is made useful in some part of the subsequent work. Were not these precautions taken to avoid loss, the cost of instruction, now reckoned as but about five dollars per term for materials, would be largely increased.

Exercise No. 7 is one which gives practice in centering, securing parallelism of crank with crank, and in both milling and turning to size and exact form. The students who can do this bit of work satisfactorily are well advanced, but they are not allowed to stop here. No. 8 is a somewhat similar exercise, but rather more difficult. One piece is turned from several centers; being centered first to turn the shaft, then to turn the two cams, both of which must be set exactly right in respect to the line of the shaft and to each other. Their eccentricity is $\frac{1}{2}$ inch. No. 9 is a hand wheel for one of the speed lathes built for the shop. It gives practice in chucking, boring, turning, and the production of circular sections of rim, and nice little touches in getting the several members into correct relations of contact and symmetry. The twenty lathes lately constructed for the new extensions are fitted with samples of this piece. The finish must be as acceptable as the working to size.

In No. 10 the work is done entirely with hand-tools, and brings out the native talent of the novice—if he has any—with good success. Thumb-screws and nuts of this pattern find many uses. No. 11 illustrates the screw-cutting exercises, and the product is another contribution to the stock in the store rooms. Round, slotted and hexagonal heads are produced, giving practice on the lathe and the milling machine, and in the adjustment of the latter, such as find many applications, later, in the work of the graduate. No. 12 is a job in facing nuts—one with which the old-fashioned apprentice was sometimes made altogether familiar by weeks or even months of constant practice. The nuts are faced on the lathe with "water-cut," and milled off on the milling machine. The thread is tapped in the smaller sizes, but is turned out with tools made by the students in the blacksmith shop, in the case of the larger ones. Square thread-cutting is illustrated by No. 13, and this gives exercise in both lathe and drill press work, the latter in getting the two holes in the head of the right size, and in exactly the right relation as to position. This piece, when finished, makes the screw of a screw-jack, numbers of which are made in the Sibley College shops. No. 14 is an exercise in chuck-boring, lathe-turning and gear-cutting on the Brown & Sharpe milling machine or on the Brainard tool. The cutters used are made by the students, as another exercise in the shop, and in tempering. No. 15 is a steel mandrel, to be turned to rough size, hardened, and then ground to the prescribed finished standard. No. 16 and No. 17 are exercises in turning in steel, finishing, with taper shank, straight and "spiral" fluting, hardening, grinding, backing off and tempering, and thus making a finished tool of standard size, as a contribution to the stock.

Nos. 18 and 19 are mills of different pattern, giving exercises in the use of the milling machine and cutters. No. 20 is a good exercise, producing a reamer by just such work as No. 16. No. 21 is a sizing tool, a simple but profitable bit of practice. No. 22 is a group of exercises in making twist-drill cutters of a pattern devised by Mr. Anderson and adopted for general use in appropriate work. A formula is given the student from which a templet is made, to be used in turning a blank, from which blank the teeth are then cut in the milling machine. The teeth are next dressed off with a file, hardened, ground and tempered. The peculiar form of cutter shown gives a perfectly straight lip to the drill cut. No. 23 is a construction adopted for drills larger than $1\frac{1}{2}$ inch. A taper socket is first made, and on this are fitted the drills, the hold being secured by means of the pin and slot seen in the illustration. These tools are found to work well, and there is comparatively little trouble experienced in hardening and tempering them. As an exercise in practical construction they are valuable. So well, we are told, are the students drilled, before coming to this work, that it very rarely happens that one is spoiled in the making. No. 24 shows a taper-socket reamer, constructed on the same plan and giving a similarly excellent exercise in tool work. No. 25 is also an exercise in the making of twist-drills, of smaller sizes, and illustrates the standard drill of the Sibley College shops.

What we have shown by no means concludes the list, but are given as samples, and to show the drift of this educational department of the college.

It is said that a finely polished lusterless surface can be produced in steel by rubbing, after tempering, on a smooth iron surface with some ground oil-stone till it is perfectly smooth and even, after which it should be laid on a sheet of paper, and rubbed backwards and forwards till it acquires a fine dead polish.—*Engineering.*

Blount's Automatic Water-Gauge Valve.

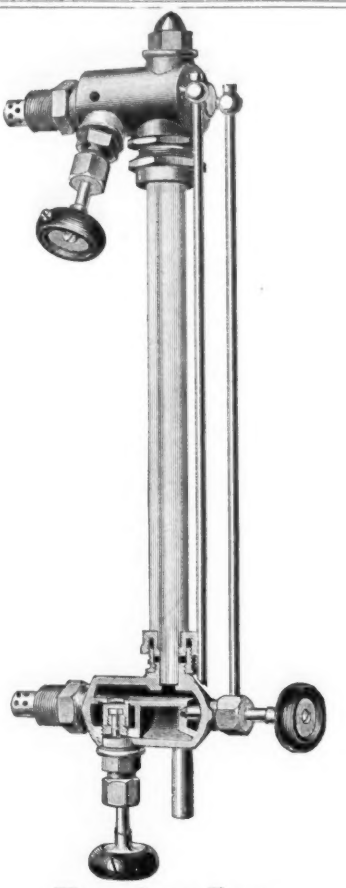
This valve has a play on the stem, and can therefore be screwed tight against the seat, held away from the seat, or put into position to work automatically.

In the latter case the screw head in the edge of the wheel is always on a line with the mark on the shell.

When, by the breaking of the glass tube, the pressure is removed from the top of the valve, the latter rises on the stem and seats itself at once; therefore the pieces of glass fall, instead of being thrown around. The valve itself is under perfect control from the outside by means of the stem, therefore by screwing the latter up and down sediment can be easily dislodged and blown out.

The stuffing box is in two parts, so arranged that any packing may be applied, and also easily removed, so that no time is wasted in setting a new tube. In blowing off, the valves should be held away from the seats.

The manufacturers are the Wentworth Manufacturing Company, Boston, Mass.



WATER GAUGE VALVE.

Spur Wheel Moulding from a Segment and Spindle.

BY S. BOLLAND.

No foundry should be without good facilities for moulding circular castings with sweeps; for if the necessary rig was always on hand, numerous methods would suggest themselves to the founder, whereby much would be saved both in time and lumber in the making of many such castings.

Much loss is suffered by some firms because of the supposed cost of preparing the spindle and its adjuncts for this class of work, but I am persuaded that this supposition is purely imaginary, as I shall attempt to show.

All that is needed to secure good work by this method is to have the spindle of sufficient strength to support the sweep, and resist the thrust whilst it is being forced round.

Fig. 1 is a plan of the center required, and Fig. 2 is a sectional elevation of the same with the spindle set in; its dimensions are as follows: Arms, 2 feet radius, 9 inches wide, 1 inch thick all through. The spindle shown is $2\frac{1}{2}$ inches diameter, tapered to $1\frac{1}{4}$ inch along 13 inches of its length at one end, so that, the hub in the center being 12 inches deep, 1 inch of the spindle will protrude. Have the spindle no longer than is absolutely necessary to allow of 9 inches below the casting to top of center, and as much above the mould as will allow of the sweep being firmly attached, as shown at Fig. 3.

Let the spindle be turned and tapered in the lathe, and after moulding the center (in open sand) set it on end in the hub, pressing it down about 1 inch, taking care not to have the center reach above the taper when cast. To insure an easy withdrawal of the spindle, have a little tallow melted thin, with which to cover the taper end; over this sprinkle a little fine parting sand, and be careful, when pouring the center, not to direct the stream of iron against it. Another important feature is to have the spindle at right angles with the center.

By referring to Fig. 3, it will be seen that two kinds of arms are shown for securing the sweep. The one shown at *A* will doubtless recommend itself to most moulders, on account of there being no machine work needed in its construction. The one at *B* needs boring and also fitting with a set screw; it is less troublesome to set, but it must be remembered that it can only be placed on and taken off by passing over the top of the spindle, whilst the one at *A* can be released on any part of it, by simply knocking out the key. Fig. 4 shows a bushing or collar to be screwed fast to the spindle when it is thought best to turn the arms loose on the spindle, as is sometimes the case.

The spur wheel illustrated in this article is about 6 feet in diameter, 12 inches deep, 8 inches center core, and hub 14 inches deep, 4 inches thick; the arms have a center web and come flush with the rim, as shown in elevation on right hand half of Fig. 5. For such a wheel the center must be sunk 2 feet below the floor, and to set it securely, let the end of each arm rest on an iron block or weight firmly bedded down. **This done**, a hard bed is made level with the floor and swept off as seen at Fig. 3. The sweep and arms are now removed and a washer pattern, same diameter as the hub, and as thick as the distance the hub extends past the face (which in this case is 1 inch) is slipped over the spindle; the hole in center of washer being made to fit the same, to insure a correct match with the cores. The cope is now rammed over the surface and staked at the corners; these stakes must be protected during the process of moulding the wheel, so that the cope, when closed, will be sure to rest in its original position. After the cope is lifted off and finished, a hole of the requisite dimensions must be dug and the washer again slipped over the spindle, point downwards, and bedded correct to depth. This can be accomplished either by marks made on the spindle, or from two points set in the joint to the cope sweep, on which a straight-edge can rest.

The bottom bed can now be swept off similarly to the top, only that more care is needed to have the parts which form the casting as true as possible. I am aware that in ordinary practice all that is now required is to place the dry sand teeth cores in position, and set in the arm cores, also made of dry sand; but a large experience in this class of work has convinced me that it is impossible to make a true spur wheel by this method; for, however careful we may be to avoid it, the ugly fact still remains, that no two cores are alike; consequently, the wheel must be untrue throughout its whole circumference, and is therefore untrustworthy. Spur wheels thus made usually have short lives, and such as do not crash during the first few revolutions are broken piecemeal, the faulty teeth snapping off from time to time, to be replaced by wrought-iron ones at considerable cost.

Fig. 6 will explain a method which obviates the difficulties spoken of. The corebox *A* for the arms is made so that the outside shall correspond with the thickness of the rim; on this the teeth must be secured, and the best way to effect this is to dovetail them on, so that they can be removed when not in use. After laying out the arms bed down lifting plates shown in plan at *B*, Fig. 6, and in section at *A*, Fig. 5. The pattern can now be placed over and the cores rammed. I have shown a core ready for lifting away at *C*, Fig. 6; when the cores are all out, the way is clear for moulding the teeth. In this drawing I have purposely left out the spindle, that I might more clearly explain the arrangement for setting the teeth. The pattern sets back a little from the spindle, but an iron guide *D* is let in, which fits accurately and clips the spindle. This guide has a slot hole in it, through which a good screw secures it to the pattern. By this method the pattern can be moved in or out if it should be found necessary to alter the diameter. This, of course, will be discovered when the segment has been tried all round. Be sure of a well defined mark all round the teeth before commencing to ram, and set the segment to them accurately each move that is made, and the result will be a comparatively true wheel.

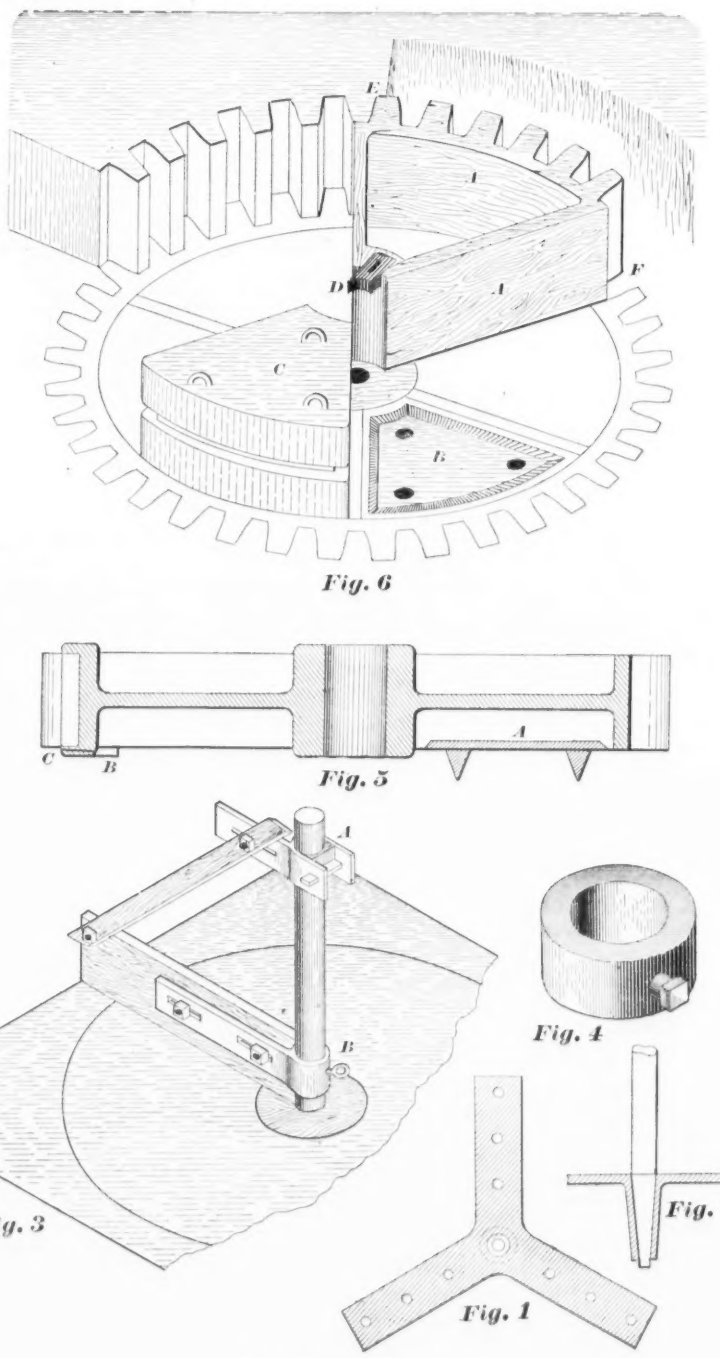
The drawing shows the segment as having been rammed once and moved around; the side of tooth is set against the sand at *E* and also to the tooth mark at F. When the teeth are all rammed the spindle can be taken out and a piece of waste thrust in the center hole, over which sand can be rammed firmly, level with the bottom of core print.

The advantage gained by ramming the cores on the bed will be appreciated when the mould is ready for closing, as the feet will guide them to their respective places with absolute correctness. Another advantage is that cores and outside, being made from the same pattern, insures an exactness which cannot be expected by any other method.

Should it be required to cast a shroud over the teeth on the top side, cut the cope sweep to correspond with the form and position of the shrouding; this will leave a sand pattern, as it were, the imperfections of which can be made good by finishing to a short segment pattern when the cope is lifted off. But should the shrouding be needed on bottom side as well, it will then be necessary to put back the bottom sweep (after the cores are all out) fitted with a tongue which will not only form the shrouding, but will also strike out clearance sufficient to allow of the segment being withdrawn after the teeth are rammed over it as shown at *B*, Fig. 5.

A good method of making the segments to be used in forming the bottom shrouding, is to halve them along their length so that they fit wedge form at the ends, the top half to have its thickest edge to the front; this of course allows the upper half to slide down the incline, freeing itself from the teeth as soon as it is touched; a desideratum to be appreciated. My meaning will be seen at once by consulting Fig. 5, at *C*.

The space at *B*, Fig. 5, will of course require filling up after the teeth are all rammed; this can be accurately done by using a segment made to clear the teeth when it is drawn out. The teeth will serve as a guide to set it by, and a few holes can be bored, through which spikes can be thrust to hold it in place whilst the sand is being pressed against it.



SPUR WHEEL MOULDING.

Angus Sinclair, in the *National Car and Locomotive Builder*, thus refers to a new valve gear on the B., C. R. & N. railroad:

The new valve motion is the Grimes radial gear, and is the invention of a St. Paul machinist. It is in use on several stationary engines about St. Paul, and gives eminent satisfaction. It has been applied to a Brooks mogul belonging to the B., C. R. & N., but has not been in service long enough to demonstrate what it will do, although it promises to do very well. The motion for the valve is taken from a single eccentric. The eccentric strap-rod works upward at right angles to the center line of motion, and operates a block moving in a slotted link attached to the tumbling shaft. The angle at which the link is set determines the valve travel. By the arrangement, which has remarkably few parts, the valve receives the quickest motion to open and close, of anything I have ever seen operating a single valve.

LETTERS FROM PRACTICAL MEN.

Stress in a Rope.

Editor American Machinist:

Glancing hastily at your reply of January 28 to E. G., Philadelphia, about stresses in a rope passing over a sheave, it occurs to me that E. G.'s friend may have had in mind a case illustrated by the accompanying Figs 1 and 2.

Suppose a man weighing 100 pounds suspends his whole weight from a sheave by taking hold of the ends of a rope passed over a sheave, one end in each hand, as indicated in Fig. 1. The pull on all parts of the rope (neglecting weight and stiffness of rope and friction of pulley), will, in Fig. 1, be half of 100 pounds—50 pounds, and that on the short rope supporting the pulley will be 100 pounds, for it sustains the entire weight.

But if the man fastens one end of the rope to the nail, and suspends his whole weight from the other end of the rope, as in Fig. 2, then there is a strain of 100 pounds in all parts of the rope, and the short rope supporting the pulley will bear 200 pounds; for the downward reaction of the nail, which is required in order to balance the weight of the man, acts on the rope as a second weight of 100 pounds. In fact, the stresses would remain the same if we untied the rope from the nail, and attached to that end of the rope a weight of 100 pounds.

If, therefore, the long rope in Fig. 1 were capable of sustaining only 75 pounds pull, or if the short rope were capable of sustaining only 150 pounds, then the man would fall when he adopted the expedient shown in Fig. 2.

The foregoing follows from the principles stated in your answer to E. G.

Fig. 3 merely illustrates the stresses in case the two parts of the rope are not parallel. The man weighs 100 pounds, as before. Draw the vertical line *a b* one inch long, and upon it, as a diagonal, draw the parallelogram *a c b d*. Then for every inch in *a d* or *a c* there will be 100 pounds pull throughout the rope. X. Y. Z.

A Reminiscence.

Editor American Machinist:

In May, 1857, I was the only machinist regularly and steadily employed, as such, in the watch and watch-case industry in the United States. In thirty-one years there has grown up an industry which employs over 700 machinists to make and keep in repair the watch and watch-case machines and tools.

In May, 1857, there were fifty operatives, making five watches per day. Now there are at least 8 000, who are turning out 5 000 movements per day, and case factories, turning out as many cases, with $10,000,000 of capital in the movement manufacture and $5,000 000 in case manufacture; also $200 000 in watch tool and machine manufacture. All this has been developed in thirty years, and to-day England is looking to us to know how to make watches, as, thirty-five years ago, she came to learn how to make guns. A. Webster.

Removing Iron Turnings from Babbitt Metal.

Editor American Machinist:

If "A. B. C." will simply melt his mixture of babbitt metal and iron turnings, he can pour off the babbitt and leave the iron in the ladle. I have tried it, and the separation is as thorough as could be desired.

F. B. Hamilton.

Editor American Machinist:

"A. B. C." can take the iron chips out of his babbitt with a horseshoe magnet, if he has but a small amount. If in the business, and has large quantities, there are machines that will do it cheaper.

W. E. Crane.

Waterbury, Conn.

Editor American Machinist:

In your issue of Feb. 11th "A. B. C." wants to know how to remove iron turnings from babbitt metal. If he will melt the babbitt metal he will find that the iron and other dirt will rise and float on top, then he can skim off the top, and his babbitt will be left clean. O. Akerley.

Editor American Machinist:

"A. B. C." can remove the iron turnings from babbitt metal by heating in a ladle.

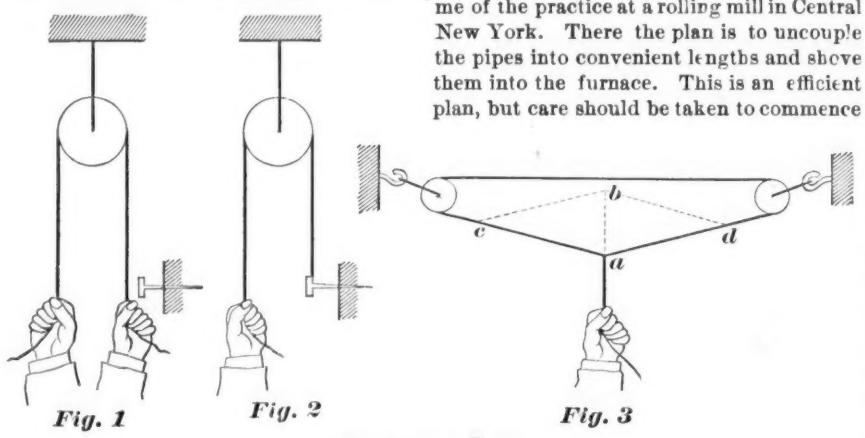


Fig. 1 Fig. 2 Fig. 3

Stress in a Rope.

After the fusion point is reached, add a little oil or resin; the iron, being a lighter metal than the babbitt, can be skimmed off the top, leaving the babbitt clean.

Wm. H. Baker.

[We have received many more letters on this subject to the same effect as those published above.]

Hardening Cast-Iron.

Editor American Machinist:

Looking over the "Questions and Answers" in the American Machinist of Feb. 4, 1888, I find your answer to question 51, which reads as follows: "Is it possible to case-harden cast-iron?" A.—"Not that we are aware of."

To-day I had to turn 16 cast-iron rollers, all of which needed case-hardening, as otherwise they would wear off too fast. We case-harden cast-iron by heating it to a good cherry red, apply potash, and dip it into the water, the same as we do for wrought-iron. I send you one of those rollers for inspection.

Talking to the foreman about this matter, he said that he knew how to case-harden cast-iron ten years ago. He also told me that he once saw a cast-iron planer tool post, which was case-hardened.

Louis Kunz.

[The roller spoken of by our correspondent is about 1½" diameter by ¾" wide, and has the outward appearance of case-hardened wrought-iron. It is quite hard, not only upon the surface, but upon breaking it we find it hard all the way through, so that it cannot be filed. The fracture has the appearance of ordinary cast iron. Thus it would appear that this is a method of hardening cast-iron, which would probably be useful in many places, but it is not a case hardening process, according to the generally accepted meaning of the term.]

Becoming Locomotive Engineers.

Editor American Machinist:

I see in the Question and Answer column lately there have been inquiries from boys wishing to become locomotive engineers, asking what would be the best course for them. You answered by telling them to study books, and work in the shop, but you said nothing about firing. Now I think the books and shop are all right, but at the same time I think a man should never be allowed to run on any road unless he has fired for two years at least. I never worked in the shop, but I fired four years, and read all the books I could get on the subject, including Modern Locomotive Construction, now running in the American Machinist.

Williamsport, Pa. F. M. Banks.

[Our correspondent is right about the firing part. The answer to the question to which he refers was to a boy of 16—too young to begin firing—and the answer aimed to tell him how to get on the footboard, where his first work would, or should, be firing. The course of our correspondent was an excellent one. A locomotive fireman or engineer cannot read too many good books on the locomotive.]

Ice in Steam Pipes.

Editor American Machinist:

The various plans given in the American Machinist for thawing out pipes reminds me of the practice at a rolling mill in Central New York. There the plan is to uncouple the pipes into convenient lengths and shove them into the furnace. This is an efficient plan, but care should be taken to commence at one end and not go too fast. Too much hurry will sometimes thaw the middle and blow ice plugs out of the ends, like a ramrod fired from a gun, which is uncomfortable for whosoever is in range. O. M.

Shop Notes.

No. 2.

The lathe was running backwards. The turning tool was upside down. The workman was turning a piece of work that was fastened to the face plate.

To my question why the lathe was running backwards, the workman answered, "To stop its chattering. I have often tried—always with success. It is a common thing in shops where I have worked."

This was a new idea to me. The lathe was not chattering. I asked the foreman what he thought of it. He said that, when running forwards, the lathe did chatter.

After getting seated in the car, I told this to my acquaintance over the way. It was new to him, yet he did not like it. He said: "It is an admission of working on a poor tool. I would suggest tightening up the bearings of spindle, as it is well known that any job can be done good enough when the lathe is in proper condition for that work. Better have more preventive and less cure. 'An ounce of preventive is worth a pound of cure.'"

I do not know who is authority for the statement that an ounce of preventive is worth a pound of cure. I have no direct proof of its correctness. Why an equal weight of preventive should always be worth just sixteen times a cure is a mystery. Perhaps an apothecary's pound is meant. If so, we would have to pay for the preventive only twelve times the price of the cure. A cure is good enough for most of us.

Why a new invention nearly always saves exactly 25 per cent. or exactly 50 per cent. over the old way is another mystery. But when the invention saves 100 per cent. I know just what to do—let the saving be done in the other man's establishment. When the inventor says that he can save it all—100 per cent.—I know that he is drawing on his imagination when facts fail.

Running a lathe backwards, with the tool upside down, can hardly be called a *cure*. It is only a remedy. It is a sort of sleeping powder or an opiate. However long we run the lathe backwards, we have not cured it of chattering, because no sooner do we run it forwards, than it again commences to chatter.

However rigid the lathe, however well fitted the bearings, however tight the boxes upon the bearings, the spindle will always be more firmly bedded in the front box when the tool is cutting downwards than when the tool is cutting upwards.

If threaded, a face plate may unscrew. Yet I should think it could easily enough carry an ordinary finishing chip. The face plate I saw running backwards was not threaded. Jarno.

Prentiss' "Rapid Transit" Vise.

We illustrate herewith a new style of vise, recently brought out by the makers of the well known Prentiss' vise.

In this vise the nut is so arranged as to open and close at will, to enable the vise to be quickly set to receive work of any size, avoiding the necessity of turning the screw for that purpose.

Fig. 3 shows the general appearance of the vise, and Figs. 1 and 2 its construction. It will be seen that the nut is divided horizontally into an upper and a lower half. Each part of the nut is prolonged downward, to form a rectangular slide, which fits into a recess formed in the body of the vise for that purpose. Between these two slides the "operating bar" *B* passes. On each side of this bar are lugs, which are inclined to suit the angle of, and fit into, the inclined grooves *C*, one of which is cut in each slide or part of the nut. The grooves are inclined in opposite directions, and a movement of the bar *B* lengthwise raises one part and depresses the other, thus opening or closing the nut. On the lower side of the bar there is a notch *D*, by which it is held in the position shown, until the jaw is set at the required point, when, by raising the bar slightly, the hook is disengaged and a spiral spring moves the bar in, closing the nut. By drawing out the bar until the hook catches, the nut is opened. By this construction simplicity is secured, and the advantages of a rapid transit vise secured, without in any way impairing or interfering with its efficiency as an ordinary screw vise.

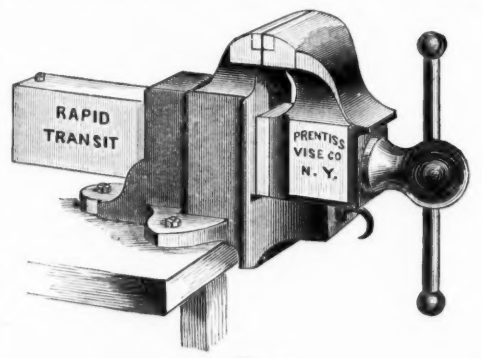
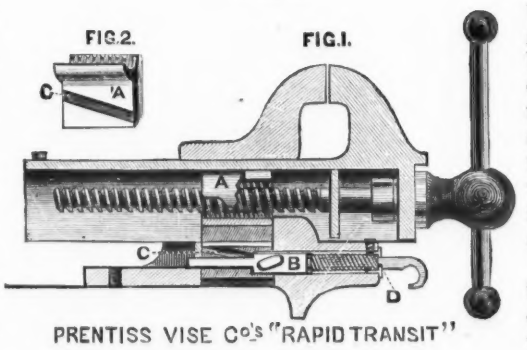


Fig. 3.



PRENTISS VISE Co's "RAPID TRANSIT"

As the cut indicates, the casting is so formed as to support the nut close to the screw, on the side from which the strain comes. This feature is also applied to coach makers' vises, as well as the kind shown in the cut. They are furnished with either stationary or swivel bottoms, as desired, and are manufactured by the Prentiss Vise Co., New York.

The Tool Room.

By Fred. J. Miller.

To machinists, toolmakers and others whose shop experience has been in a certain line, the advantages of a tool room are familiar, and the arrangement and management of them equally so.

But a mechanic needs to go about amongst shops but very little to see that this is a matter which is not appreciated at anything like its full value, and but very

imperfectly understood in very many if not a majority of shops.

A question which often bothers machine shop owners is, can I, with my small shop, afford to maintain a tool room? or, how large must the shop grow before I can afford a tool room?

In answer to this question it can with safety be said that there are few shops so small that they can afford to dispense with a tool room, and that the shops in which the money required to fit up such a department would not be a paying investment are really very rare.

One of the first requirements of a machine shop is tools, without which very little can be done. It follows that if tools are required in order to do work, the better the tools are, the better the condition in which they are kept, and the more easily and quickly they can be found when wanted, the better will be the results obtained from the use of them. If, when a machinist has occasion to use a certain tool, he has to spend half an hour in making inquiries and hunting for it, and then finds it in such a condition that he must spend about an hour more in getting it ready to use, the object for which the tool was made or purchased is well-nigh defeated, and the benefits which should result from the possession of it are not realized.

This is a consideration which applies equally well, whether the shop be large or small. All tools should be kept in the best possible order, and when wanted should always be obtainable in the shortest possible time. There is but one practical way of securing this condition and maintaining it and that is by the establishment of a tool room.

If circumstances are such that it is not advisable, or perhaps admissible, to have a lathe or other machine tools in it, then it may be simply a place provided with shelves and other conveniences in which to keep tools and supplies, the key of which should be in the possession of the foreman or one of the men whose place is near it. All tools, including files, should be kept in it, and the same system of checking and accounting should be used as is practiced in the more elaborate tool rooms, and which is to be hereafter explained.

Of course this plan is far preferable to letting the tools take care of themselves; but, in order to reap the full benefits of a tool room, it should be large enough to admit of most, if not all, of the tool work being done there, and one or more men should work in it and be held responsible for its management.

The arrangement of the room will, of course, depend upon circumstances, the location, amount of room available, and the character of the work done in the shops being taken into consideration.

Usually the light will come from one side only, and along this side the machine should be placed, while the cupboard, shelves, racks, and other furniture necessary for the convenient arrangement of tools and supplies can be arranged round the other sides.

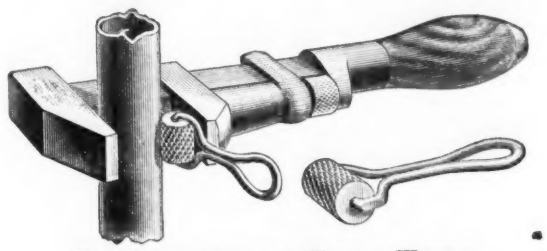
The window through which to receive and hand out tools should be located with a view to convenience both of the men inside and those who may have to go there for tools.

Outside of this window, and even with the bottom of it, there should be a broad, strong shelf, and a similar one inside. Above it should be fixed a small bell.

As near as possible to the window should be arranged those tools and supplies which are most frequently called for, such as tap wrenches, hack-saws, belt fastenings, etc. Along one side of the room there should be a number of pigeon-holes for files. They should be on the floor, and may be about three feet high and provided with doors, each door covering say twelve divisions or pigeon-holes. The files can be classified according to their length or their cut, and the kind of files to be found within any door should be indicated upon it.

Over this file cabinet may be placed the shelves for taps, dies, reamers, drills, etc. They should incline outwards, and be subdivided by small strips of wood nailed on, so as to separate each tool from the others. The taps should be placed together on one shelf, and arranged according to their size, and each subdivision of the shelf marked with the size of tap belonging there. The arbors, reamers, drill-gauges, and other tools should each be assigned to a shelf and arranged in the same way.

Along another side of the room may be placed shelves, racks, etc., for keeping jigs, belting, fixtures, drawings, and all the promiscuous and unnamable things which may properly be kept there. But each article



PIPE ATTACHMENT FOR MONKEY-WRENCH.

should have a place prepared specially for it, and should always be kept in that place when not in use.

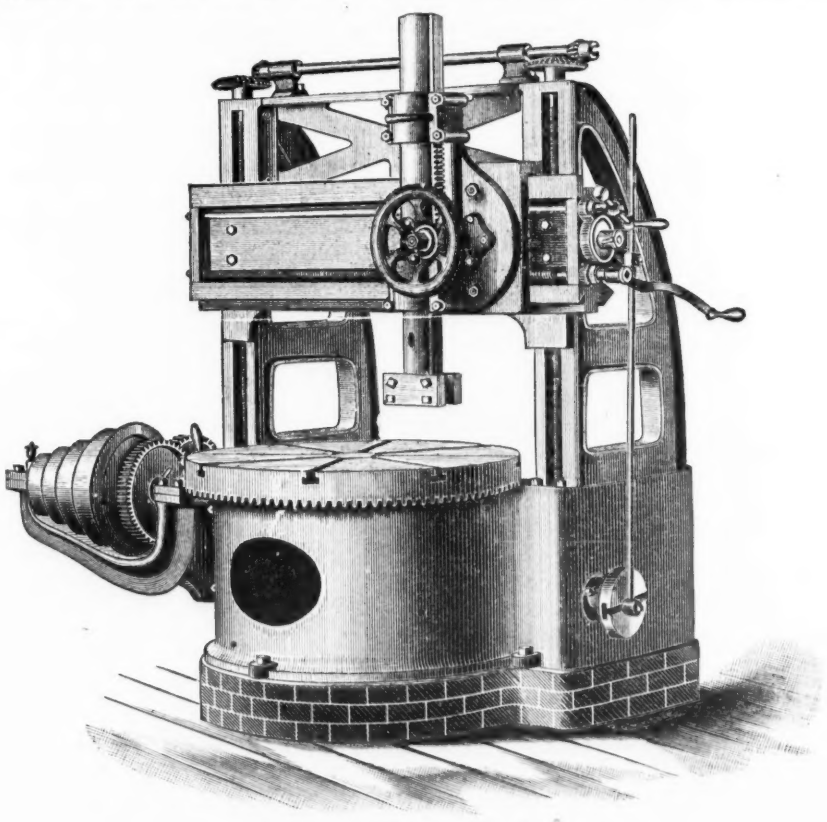
Having things arranged in this manner is a vital part of the check system, which, in some form or other, is in use in many of the best shops of the country, and is probably the most simple and practical way of keeping account of tools ever devised.

Each workman whose work is of such a character as to require the use of tools which are kept for general shop use, and must consequently be returned to the tool room after use, is provided with as many checks as may be thought necessary, usually five. Supposing there are likely to be twenty such men, there would be one hundred checks. They should be of brass, about an inch in diameter, and stamped with the name or initials of owners of the shop. Now, considering them to be arranged in groups of five, the first group should all be stamped with figure 1, the second figure 2, and so on, the last group or set being stamped 20. These figures should be comparatively large, and in the center of the checks, so as to be the most prominent character upon them. Then the checks of each set should be numbered consecutively from 1 to 5 with small figures. Each check should also have a small hole through it, so it may be hung upon a small brad or piece of iron driven into the wall for that purpose.

Such tools as monkey-wrenches and hammers, which are furnished by the shop are stamped with the name of the proprietor, and numbered consecutively, lists of these numbers being kept in a book provided for the purpose. Now, suppose a new man applies at the window for tools. Those which, from their nature, he will be likely to retain until he leaves the shop, or they are worn out, are charged to him in an indexed book, kept for the purpose, the number stamped upon them, if any, being noted. He is then furnished with a set of checks, and they are charged to him by their number. Now, should he apply for a drill, arbor, reamer, tap, or anything of that sort, he presents one of his checks. The tool is taken from its place, given to him, and his check put in its place. When he returns the tool in good order his check is returned to him.

It is thus apparent that any one calling for a tool will be able to obtain it promptly, without any search for it, or, if it is not there, the number of the check which is in its place will indicate who has it. For convenience, there should be a list of the numbers of the checks posted up in the tool room, having opposite each number the name of the man who has the corresponding set of checks. The men in the tool room soon become able to associate all the names with the proper numbers, however, so that the list can soon be dispensed with. When files are worn out they are returned and replaced by new ones, no account of such exchanges being kept on the book.

The tracings or blue prints used in the shops should, if possible, be mounted upon cardboard, or other suitable material, cut to uniform size, classified, and placed upon suitable shelves. When this is done, the check system can be applied to them also. At the Atlas Engine Works, Indianapolis, they arrange their blue prints in that way, and all machines, and parts of machines, are designated by symbols, upon a plan



½ BORING AND TURNING MILL.

similar to that described in the AMERICAN MACHINIST, issue of September 10, 1881.

All drawings and blue prints are marked with corresponding symbols. They have a board about six feet square, in which are driven a number of small hooks on which the checks can be hung. Under each hook is marked a symbol corresponding to some drawing, so classified and arranged as to be easily found. When any given drawing is called for it is taken from its place and the check hung upon the corresponding hook. In this case they lacked the room to place this board upon the wall, so they arranged it to slide up out of the way, attaching cords, and balancing it, the same as a window sash.

A good many shops do without tool rooms because they think there is no room to spare for them; but it will be found that if all the tools and fixtures about a shop are gathered up and systematically arranged upon some such plan as indicated, there will be more spare room than before, and the appearance of the shop will be much improved.

Of course it is not necessary that the men and machines in the tool-room be devoted exclusively to tool work, but if the shop is small, and not a great deal of work is required on tools, other work may be done, and thus the tools and men kept employed. The tool work will be better and more economically done in this way, because men specially suited for doing it will be selected, and they will naturally provide themselves with the best tools and appliances, and, in short, will attain the maximum efficiency, as men generally do who devote themselves especially to any certain class of work.

The object of the numbers on the monkey-wrenches is that, being charged to the men by numbers, by that means each man is charged with a certain specific wrench, which he can identify, and prove his lease of, at any time. And when he returns it, it is known to be the same one, and not some one else's.

In justice to the men, each one of them should be furnished with a drawer or cupboard, in which he can place his belongings and lock them up; otherwise it would be unfair to hold them responsible for the loss of, or damage to them.

Ambler's Pipe Attachment for Monkey-Wrench.

The accompanying engraving shows a novel pipe attachment for use with the monkey-wrench, and the manner of using it.

The principle upon which it acts will be readily understood by all mechanics, and it will be seen that by its use an ordinary monkey wrench can be used for turning any round object, such as pipe, round iron, stud bolts, etc. Not being fastened to the wrench in any way, a slight backward turn loosens it and makes the wrench immediately available for its ordinary purpose.

It consists simply of a small roller of steel, knurled and tempered, with a wire handle attached for convenience in applying it. It will be noted that there are three points of contact, and none of them sharp, thereby avoiding unnecessary injury to the pipe, and also that there is nothing about it which can well be broken or disarranged.

For machinists, blacksmiths, and others who frequently have occasion to use such a tool, we should think it would prove quite useful. The detached view is about half size.

It is made by A. A. Ambler, Springfield Ohio.

The Burnham Boring and Turning Mill.

The accompanying cut represents a boring mill as constructed by the Battle Creek Machinery Company, Battle Creek, Mich.

It is designed especially for medium sized work, and will do all kinds of boring and turning within its range. It is capable of boring and turning a pulley 40 inches diameter and 20 inch face.

As will be seen by the cut, the design is heavy, the cross-rail being broad, and with a long bearing upon the housings, to prevent yielding on heavy work. The boring spindle is balanced, and has automatic feed with quick return at any angle.

There are two sets of back gears, giving with the changes on the cone a wide range of speed. The face plate is 36 inches diameter, and has a bearing near the outer edge, on which it runs while doing heavy work. The spindle runs on a steel step, by means of which the face plate may be raised off the angular bearing when doing small or light work. The machine weighs, complete, about 3,500 pounds.

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The Educational Movement Amongst Stationary Engineers.

There is amongst stationary engineers in this country a quiet educational movement going on in matters relating to facts and principles underlying their work, that is likely to have an important influence on industrial affairs. This educational movement is noticeable in all classes of workmen, but amongst none more so than amongst the men in charge of the motive plants of the country. It is fortunate that this is so, for nowhere about a manufacturing establishment is there an opportunity to apply intelligence, good judgment and a good deal of knowledge to better purpose.

Stationary engineers comprise various grades of workmen, from the chief engineer of some large establishment, who is usually an accomplished mechanic, carrying along grave responsibilities, to the mere stopper and starter, who is engineer by courtesy only, and whose place is likely to be soon filled by quite another man, so far as qualifications are concerned, though perhaps by the same individual. Men ignorant of everything except the mere mechanical details of their work will soon have no place as stationary engineers.

The formation of associations, at the meetings of which practical matters are discussed by the members, and before whom experts are glad to appear, has had a good deal to do in inciting engineers to read and study. Men brought together in the way they are brought together through these associations, soon come to see what they lack, and there is sure to be a laudable ambition not to be surpassed by their fellow members. Progress once begun in such matters is never likely to stop.

A glance at the "Question and Answer" columns of the AMERICAN MACHINIST for the past year will give a fair idea of the interest which stationary engineers take in matters outside the mere details of their work. Out of about a thousand questions that went into print it will be seen that considerable more than half were asked by stationary engineers. These questions embrace many things in the way of steam engineering, steam engine management, construction, etc. Some of them are such as require a good deal of thought to answer, and no little attention in order to get the answer into the space it is possible to devote to the department of Questions and Answers, and still make it carry the information sought in plain terms. Scarcely a week passes that several questions are not asked by engineers, either of which could be made the subject of a lengthly article. This is of interest only in that it shows that engineers, amongst whom we have a large and increasing number of readers, are not at the present time behind any class of workmen in the way of seeking information.

We believe it is the universal verdict of all who have addressed assemblages of stationary engineers upon practical matters that nowhere can more attentive and appreciative audiences be found. In many of the assocations the use of the indicator has been taken up, and where at the beginning none were acquainted with its use a great many have soon learned it. In one instance of which we have knowledge, the use of the indicator was begun by several of the members, who clubbed together to buy an instrument, and within a year some of them could almost be called experts in its use. At least they had learned to use it intelligently in any practice they are likely to have in the line of their work. This knowledge has been gained by hard work—night work on some disordered engine, and all night if necessary. It has been gained by turning hours of leisure into hours of work.

The moral of all this is—and it is plain—that the stationary engineers are working hard to place themselves and their work on a higher plane. They are making hard, honest endeavors in this direction, and such endeavors, persisted in, were never yet known to fail.

Experience.

Scarcely any of the modern arts are practiced in these days without the help which is to be derived from the experience of men who have in the past practiced these arts.

The knowledge resulting from this experience may be imparted from one artisan to another, and from one generation to another, in various ways, by word of mouth or by written directions, and these written directions may be incorporated in a book, and become a part of the common fund of knowledge on that subject; but no matter in what form it presents itself, its value should be estimated solely upon the ground of its accuracy and the amount of experience from which it is derived.

The "modern science of war," as studied by all students of military science, and as practiced by the greatest and most successful generals of all nations, is made up entirely of the experience of soldiers who have in the past won and lost battles, many of them before the discovery of this continent, and whose successes and failures, and the causes which brought them about, have been recorded by historians.

The man who should assume that he was a "born general," competent to direct the movements of an army, and lead it to victory, solely by reason of his superior talent, or by reason of the knowledge gained from his own individual experience in war, and without having availed himself of the knowledge of the art of war which is to be gained by the study of the recorded experience of others, would be likely to be regarded as the possessor of much more egotism and vanity than ability. No nation would think of intrusting such a man with the direction of its armies.

The bulk of the knowledge in possession of the world to-day is derived from the recorded experience of preceding generations. No man, however talented he may be, nor however wide his individual experience, can hope to possess as much practical knowledge of his business as he who, in addition to his own experience, adds the knowledge to be gained by the experience of his predecessors who have trod the same paths.

In no department of human knowledge does this truth hold good more than in the science of mechanics.

For hundreds of years men have been constructing machinery. Sometimes they have been entirely successful, and at other times have made absolute failures. From these failures, no less than from the successes, has been built up the science of mechanics or of machine design.

However wide the individual experience of any mechanic may be, it can by no possibility extend over more than a small fraction of the field covered by this recorded experience.

Personal experience is, of course, necessary for success in any mechanical pursuit, and he who is without it is at a great disadvantage; but, on the other hand, he who knows nothing of the experience of others, necessarily knows comparatively little, and is also at a disadvantage. If, in addition to this, he despises the experience of others and boasts that his knowledge is the result of his own experience solely, he is in reality boasting of the narrowness of his knowledge of his business, and makes himself ridiculous.

The city of New York is building an aqueduct, and, in order that the work may be done cheaply, cheap foreign labor is, for the most part, employed. The lives of the men so employed have been recklessly exposed, and accidents costing lives have been numerous, and generally without excuse. But what mainly interests the inhabitants of the country through which the aqueduct passes is, how to protect themselves against the lawless depredations of this cheap labor. When this work is completed, and the cost in human life and the general demoralization reckoned up, will it have been done cheaply? We think not.

A bill now before the Assembly at Albany has for its object the securing of full weight coal by the purchaser. It requires that coal shall be weighed by a licensed weigher, and that the name of the weigher shall be on the receipt given the purchaser. The cost of a license to weigh coal is to be one dollar per year, so it will not be an unnecessary hardship for the dealer to procure a license for his best hired man.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(85) D. T. J., Christiana, Pa., asks: How can I glue leather to cast-iron cones, so that it will be as tight as though it was riveted? *A.*—Would advise you to try the following method: Spread over the metal a thin, hot solution of good glue; soak the leather with a warm solution of gall-nuts before placing on the metal, and leave to dry under an even pressure. It is claimed that when fastened in this manner it is impossible to separate the leather from the metal without tearing it.

(86) C. A. W., New York, asks: Will you kindly inform me how small brass articles are tinned similar to the way pins are tinned? *A.*—Make a saturated solution of oxide of tin (tin putty), in potash lye; add to the solution some tin filings or shavings; make it as hot as possible, then introduce the brass or copper, and it will be tinned in a few seconds. It seems to us, that, if you have a great amount of this kind of work to do, it would pay you to engage a man who is perfectly familiar with this business, as some articles may require a different treatment.

(87) T. L. B., Brookline, N. H., asks: 1. Where can I get a practical knowledge of electricity in relation to electric lighting and telegraphy? Are there any schools where this is made a specialty? *A.*—There are a number of colleges in which this science is taught; write to any one of them for terms and particulars. 2. What books on this subject would you recommend? *A.*—It is difficult to recommend any one book in particular; you will need more than one. It will be better for you to get such books as are suitable in the college in which you may take a course of instruction. Or if you want books for use at home, get catalogues of such books, and make your selections. 3. Which is the best and most practical book on mechanical drawing—self-taught. *A.*—Practical Drawing, AMERICAN MACINIST.

(88) H., Syracuse, N. Y., writes: We are sawing slots 3-64 inch wide and ¼ inch deep in brass that has been annealed and is very soft. Saws have 24 teeth, are 2 7-16 inches diameter and thinnest at the center, to give clearance, and asks: 1. At what speed should the saws run? *A.*—It depends much upon a condition which you fail to state, *i. e.*, the length of the cut. If the cut is long, giving the cutter no time to cool off, it cannot be run at the same speed as it might if the cuts were shorter. If the cuts are quite short the speed may be as high as 1,500 or 2,000 feet per minute. 2. What should be the feed in inches per minute? *A.*—This also depends upon the length of the cut as well as the speed. You can feed from 1-32 to 1-16 inch per revolution. 3. Would any different number of teeth in saws be better? *A.*—We do not think any difference in that respect would be of much advantage.

(89) J. H., St. Louis, Mo., writes: I have made a meter like the cut I send you, and would like to know how to graduate it in ounces. *A.*—See AMERICAN MACHINIST, answer to Question 239, in the issue of May 28, 1887. In connection with this answer it may be said, that if we assume a column of water one inch square, 27¾ inches high, to weigh one pound, then the length of the scale to represent 16 ounces will be 13⅞ inches long, and one-sixteenth of the length of this scale will represent one ounce. The length of this scale will always remain the same so long as the height of a square inch column of water weighing one pound is 27¾ inches; and this height is generally practically correct; but as soon as this height differs from 27¾ inches, the length of the scale will also change, because the scale must always be equal in length to one-half the length of column of water one inch square weighing one pound; but the length of scale will not be changed by changing the diameter of the glass. We believe a scale 13⅞ inches long will answer your purpose. The paper to which we refer has been sent to you.

(90) M. J. G., Cincinnati, Ohio, writes: I have charge of a tubular boiler 10 feet long, 36 inches in diameter; it has 28 tubes, 2¾ inches inside diameter; grate surface 3 x 4 feet. Under the boiler is placed a so-called smoke consumer, the bridge wall is built up to the boiler all around, and has four holes in it, each 6⅛ x 5 inches, and 12 inches in depth. Two jet blowers in the front of furnace are

employed. The boiler is pushed for all it is worth. Now what troubles me so much is the scale that is in it over the grate surface as far back as the bridge wall; it is a milk-white scale and very hard, like rock candy, and extends about one-quarter around the circumference of the shell. I think the bridge wall has something to do with it, because nearly all the heat is concentrated at this place, and has a bad result. The boiler is 18 inches above the grate. *A.*—The high temperature in the furnace, and the insufficient area of openings in the bridge wall, may have considerable to do with the formation of the scale directly over the fire. From the general description which you have sent us, we conclude that the setting of the boiler is bad, and since there is a mistake made in the distance between the grate bars and the boiler, which should be at least 24 inches, if not 30 inches, instead of 18 inches, we are inclined to believe that there has also been a mistake made in leveling the boiler, so that the end over the furnace is lower than the other end of the boiler; if so, this will be one of the principal causes of the formation of the scale over the furnace. As for smoke consumer, there is only one kind which we should use, and which, in fact we believe to be indispensable, and that kind is good firemen. In any other kind of smoke consumers we have no faith, and would not have one attached to a boiler. Of course a good fireman cannot prevent smoke if the setting of the boiler is incorrect. See to it that the boiler is properly set up, and your trouble will probably disappear.

(91) H. C. H., St. Louis, Mo., writes: 1. What established rule applies to the transmission of a given power from one shaft to another, according to the arrangement of pulleys? *A.*—It seems to us that you are laboring under a false impression, namely, that by changing the diameters of pulleys—which we assume you mean by the term "arrangement of pulleys"—the power will be increased or decreased as the case may be. Such are wrong ideas because in every case we can only obtain an equivalent amount of work for a given amount of power. We do not gain or lose any power by increasing or decreasing the diameters of pulleys. If we leave the width and thickness of belt and arc of contact out of question, and wish to find the resistance and the rate of speed which a given horse-power can overcome, then the simple rule of three is applicable, as will be seen by the answer to your next question. 2. Assume that the estimated power of a 12 inch pulley running 60 revolutions per minute is 10 horse-power, what would the increase be by transmitting this by means of belting to a pulley on a countershaft of twice that diameter; and also in what proportions would the power be decreased by reversing the above arrangement, both under favorable conditions? *A.*—To make the answer plain, let us assume that the diameter of the pulleys on both shafts are equal, and that the countershaft is arranged to lift a weight at a speed equal to the speed of the belt which transmits the power from one pulley to the other. The circumference of a pulley 12 inches in diameter is equal to 37.6 inches, and consequently the speed of belt in feet per minute is equal to

$$\frac{37.6 \times 60}{12} = 188$$

feet, and since the estimated power is equal to 10 horse-power, and since the speed of the weight to be lifted is equal to that of the belt, namely, 188 feet per minute, it follows that weight in pounds to be lifted must be equal to

$$\frac{33{,}000 \times 10}{188} = 1{,}755$$

pounds (leaving out the fraction). If we now do not disturb any of the mechanism, and only change the diameter of the pulley on the countershaft, making it 24 inches in diameter instead of 12 inches, and allowing the pulley on the first shaft to make 60 revolutions per minute as before, then the speed of the belt and speed of the circumference of the 24 inch pulley on the countershaft will be the same as before, but since the diameter of the pulley on countershaft has been doubled, it follows that the number of revolutions per minute of the countershaft will be 24 : 12 :: 60 : 30 revolutions per minute, that is, the countershaft will make only one-half the number of revolutions that it made with a 12 inch pulley, and therefore the speed of the weight which it has to lift will be 94 instead of 188 feet per minute, consequently the number of pounds in the weight will be

$$\frac{33{,}000 \times 10}{94} = 3{,}510$$

pounds. From the foregoing it will be seen that by increasing the diameter of the pulley on the countershaft to double that which it was before, we can lift a weight of double the number of pounds as before, but only at half the speed. In a similar manner it can be shown that by doubling the diameter of the pulley on the first shaft, the speed of the weight to be lifted will be doubled, and the number of pounds in weight decreased to one-half; thus: Suppose that a 24-inch pulley is placed on the first shaft and a 12 inch pulley on the countershaft, the available power to drive the shafting equal to 10 horse-power as before, and the first shaft making 60 revolutions. The circumference of a pulley 24 inches in diameter is equal to 75.3 inches; and

$$\frac{75.3 \times 60}{12} = 376 \text{ feet} =$$

speed of belt per minute. Again

$$\frac{33{,}000 \times 10}{376} = 877$$

pounds in the weight to be lifted. According to this answer, we see that with the last arrangement, we can lift a weight of 877 pounds at the rate of 376 feet per minute, which shows that by increasing the diameter of pulley on the first shaft we decrease the weight to be lifted, but increase its rate of speed. In these calculations the thickness of belt, strength of belt and friction have been left out of consideration.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Planed bevel gears. Grant, see page 16.

Link-Belting.
Send for catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Machinery Co., Chicago and N. Y.

New features on engine lathes, Lodge, Davis & Co
New features on drill presses, Lodge, Davis & Co.
New features on shapers, Lodge Davis & Co.
New features on brass tools, Lodge, Davis & Co.
Special bargains in tools taken in exchange for ours Lodge, Davis & Co.
See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

Drop presses, punches and shears. Williams White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Burnham's New Improved Turbine; sold at cost of manufacturing and advertising. Address York, Pa.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Gears, racks or ratchets, all sizes, cut or furnished. E. E. Garvin & Co., manufacturers, 139-143 Center street, New York City.

Castings for engines 2½" x 3", 3½" x 4"; vertical 3¼" x 4", horizontal propeller wheels from 10" to 42". Send for circular. F.W. Adams, Watertown, N.Y.

Berryman Patent Feed Water Heater and Purifier, and the Economic Boiler Feed Pump. Benj. F. Kelley, 91 Liberty st., New York.

Nicholson & Waterman, Providence, R. I., two 48 in. horizontal boring mills; 5 in. cutting-off machines; 14, 16, and 30 in. engine lathes.

Mechanical drawing, calculations, etc., taught by mail; just what the young mechanic needs most to know. I. D. Boyer, 324 E. 3d street, Dayton, O.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Feb. 11, p 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Brown & Sharpe Mfg. Co. have placed at No. 23 S. Canal st., Chicago, Ill., a sample line of milling machines and other machinery with S. A. Smith.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Montgomery & Co., 105 Fulton street, New York, make a specialty of fine tools for machinists. Send fourteen cents and get our 300-page illustrated catalogue.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

A. K. Mansfield & Co., mechanical engineers and experts in machinery patents; 18 years' experience; convincing references; practical working drawings; estimates, supervision. Room 256, 280 B'way, N.Y

New book on gears; Tables giving 3,094 diameters, with rules for calculation of movements of shafts, etc.; sent on receipt of P. O. Note; price, 50 cts. Address C. B. Long, M. E., Worcester, Mass.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y

Wanted—Numbers 1, 2 and 4 of volume IV., 1881; must be in excellent condition for binding; if soiled we cannot use them; for copies described as above we will pay 25c. each, and prefer to have the whole three if possible. Parties favoring us will kindly write name and address on wrapper. AM. MACHINIST Publishing Co., 96 Fulton street, N. Y.

Selling out—We are offering our entire stock of lathes, planers, drills, shaping machines, shafting, etc., at prices below factory cost, preparatory to closing our business in February. Send for list before purchasing your tools elsewhere, and save money. Fraser & Archer, 121 Chambers street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October, 23, 1886 issue, and up to and including January 14, 1888 issue, 41 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 56 articles have thus far appeared up to and including the January 21, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

MANUFACTURES

Coachman & Sloan are bulding a saw and planing mill at Clear Water Harbor, Fla.

One hundred manufacturing establishments were started in North Carolina last year.

The Lexington Model and Machine Works is the title of a new company at Lexington, Ky.

The Citizens' Incandescent Electric Light Company has been incorporated at Little Rock, Ark.

The Atchison Sash and Door Company has been incorporated to manufacture at Atchison, Iowa.

The Butterick & Etherweck Furniture Company has been chartered to manufacture at Louisville, Ky.

The Fort Smith (Ark.) Canning Company will erect buildings and put in machinery for making cans

Frank W. Coburn expects soon to double the capacity of his shoe manufactory, at New Durham, N. H.

The Muskegon Lumber Company has been incorporated at Little Rock, Ark., to manufacture shingles, laths, etc.

The Foster Car Coupling Company contemplate building a car and agricultural implement factory at Newnan, Ga.

The John O'Brien Boiler Works Manufacturing Company is the title of a new company at St. Louis, Mo.; capital stock, $100,000, all paid.

The Western North Carolina Land and Improvement Company are erecting buildings for manufacturing lumber, doors, sash and blinds, etc., at Highlands, N C.

The citizens of Fairfield, Maine, will interest themselves in any one who will start a machine shop at that place. The chances for a general repair shop are said to be excellent.

Howard & Gaylord's sash and blind factory at South Hadley, Mass., was burned the other night. All the machinery was destroyed, but the paint shop connected was saved. The factory was built nearly 50 years ago.

A consolidation has been effected of the Southern Foundry and Manufacturing Company, and the Alabama Iron Works, at Birmingham, Ala., the last named title being retained. An additional foundry 50x100 feet will be built.

The New York, New Haven and Hartford Railroad Company has made arrangements for a considerable increase to its rolling stock, having recently given the Watson car shops an order for ten drawing room cars and 30 day coaches to the Barney Smith manufacturing company of Dayton, O.

The Beckett & McDowell Manufacturing Company, Arlington, N. J., have their new foundry about completed. The new foundry is much larger than their old one, and much better arranged. They will begin work with two cupolas, but have room for a third cupola when required. Their intention is to, in addition to their own foundry work, furnish castings to concerns having no foundry.

A Cleveland, Ohio, dispatch says: Nine months ago the Britton Iron and Steel Company substituted crude petroleum for coal as a fuel in two heating furnaces and a battery of boilers in their rolling mill at the foot of Mason street, in this city. This morning the pipe for conducting the oil from the storage tank to the mill was clogged. A machinist attempted to clear the pipe by injecting steam into it. The pressure of the steam opened a valve and the oil rushed from the pipe into the furnace, where it was ignited. The flames leaped upward and set fire to the woodwork of the mill, and in less than an hour the entire mill was a ruin. The two hundred workmen employed had to run from the burning building, and barely escaped.

Curtis & Curtis, successors to Forbes & Curtis, of Bridgeport, Conn., manufacturers of the Forbes patent die stock, pipe-cutting and threading machines, etc., report business very good with them. While running all the men that their works will accommodate, thay are still behind their orders for pipe machines. During January their shipments were nearly double what they were in January, 1887, and they are looking forward to the spring trade with great expectations.

Oliver Crosby, treasurer and manager of the American Manufacturing Company Iron Works, St. Paul, Minn., writes us: "The business outlook in the Northwest for the coming year is, in my opinion, excellent. We are manufacturing a larger stock than ever before for the spring trade, our main effort being on horse-power hoisting machinery and derricks. We have lately completed a new foundry, with capacity for ten moulders." This company manufacture and sell derricks, horse-powers, hoisting engines and contractors' outfits.

The Grand Rapids (Mich.) School Furniture Company has purchased a tract of seven acres of land on which it will begin the erection of suitable factory and other buildings in a short time. The main factory building will be 50 x 160 feet, two stories the engine and boiler room, 40 x 60 feet; the kiln, 22 x 40 feet; the warehouse, 50 x 160 feet, three stories; the foundry, 148 x 178; the iron room, 50 x 60 feet; the office, 50 x 50, two stories. The buildings will be detached, reducing the loss by fire to the minimum. A side track will be laid from the main track of the C. & W. M. into the yard.

A certificate of incorporation of the Flohr Engine Company was recently filed at Buffalo, N. Y. Otto Flohr is superintendent and manager. The company will manufacture engines and machinery, paying particular attention to hoisting engines built under patents issued to Mr. Flohr: also to high speed engines of his design. Several of these hoisting engines have been built at Buffalo during the past year, and the company has now on its books orders for nearly thirty. Three of these engines were recently sold to the Hamburg (Germany) harbor commission, for use in dock improvements.

Gould & Eberhardt, Newark, N. J., are remarkably busy at their works, orders for their new drill press and automatic gear cutter being especially numerous. They are bringing out a new machine for cutting racks. The machine is entirely automatic in its action. They inform us that they have sold 100 of their drill presses during the past two years, and 100 automatic gear cutters in the four years they have been on the market. These gear cutters have gone to all parts of the world. They are at present building two 60-inch cutters for Morgan, Williams & Co.; two for the Niles Tool Works, and one for the Betts Machine Company.

A *Tribune* special says: A proposition has been made to the Navy Department by stockholders in the Inman and Red Star lines of steamers. The ships of these companies are built in England and sail under English colors, but the capital invested is largely American. One of the lines is now building two ships, to be the largest afloat—9,000 tons register and 560 feet long. The owners greatly desire that there should be some dry dock in this country for the repair of their ships, but there is not a dock at present that is capable of receiving such vessels. The dock at the Brooklyn Navy Yard is 500 feet long, and the owners of the ships suggest that it be extended 100 feet. Commodore Harmony believes that an additional appropriation of $100,000 would suffice to extend the dock to the required length. He is in favor of such a movement, and promised to bring the question to the notice of the proper officials.

Rochester, N. Y., papers contain accounts of a test of the Clark coking smokeless furnace in that city. This furnace is being introduced by the Clark's Patent Coking and Smokeless Furnace Company, of Rochester, N. Y. The *Post-Express* says: The coking furnace recently invented by Gates A. Clark, of this city, is already attracting the greatest attention. The fact that it does away with the smoke of burning coal, a nuisance which in many great cities is becoming almost unbearable, makes it an invention which will be welcomed everywhere. But the feature which attracts the attention of the economical business man is the fact that the furnace consumes just about half the amount of fuel burned in an ordinary furnace. The furnace has been subjected to the most careful and critical tests of the most skillful experts, and in each case its merits have been demonstrated.

A large manufacturing expansion at Skowhegan, Maine, appears to be the probable outcome of some important transfers of real estate and water powers which have taken place this week, in which the property hitherto held by W. S. G. Keene, including the Burrill & Robinson mill property, the Willis property and a controlling interest in the stock of the Skowhegan Water Power Company have been purchased by General John T. Richards, of Gardiner, on behalf of a syndicate of New York, Boston, and Maine capitalists, who will shortly organize as a company. Extensive pulp and perhaps paper manufactories will be erected by this company, which will be interested in the development of the Skowhegan water power to the fullest extent. Gen. Richards has also purchased the Shurtleff Pulp and Paper Mill for the Richards Paper Company, of Gardiner, which will be reorganized, and the output of the Shurtleff mill largely increased. The growing town of Skowhegan is fairly in line for development along the most profitable and enduring line of industrial expansion which is now open in the State, the working up of our native woods, and the place ought now to make giant strides.—*Industrial Journal.*

Machinists' Supplies and Iron.

New York, Feb. 9, 1888.

Iron—American Pig—The best grades of foundry are scarce, owing to the poor quality of the fuel to be obtained, but there is enough of the lower grades to supply the current demands. The continuation of the strike renders future movements uncertain, and the buying by consumers is wholly of a hand-to-mouth character. We quote Standard Lehigh brands $21 to $21.50 for No. 1 X Foundry with outside brands obtainable at $20 to $20.50. No. 2 Foundry $19 to $19.50 for Standard, others at $18 to $18.50. Grey Forge ranges from $16 to $17.

Scotch Pig—The market has continued dull, the demand being confined to small lots. We quote Coltness $22 to 22.25; Glengarnock, $21 to $21.50; Gartsherrie $21.50 to $22; Summerlee, $21.75 to $22; Eglinton, $20 to $20.50; Langloan, $20 to $20.50; Dalmellington, $20 to $20.50, and Clyde, $20 to $20 50.

Lead The market is higher and firmer than last week, with sales of about 200 tons spot and near delivery at 4.90c. and trading in speculative lots to the extent of 212 tons at 4.67½c. to 4.8-c. for February, 4.85c. to 4.90c. for March, and 4.92½c. to 4 95c. for April. The advance is said to be entirely speculative and without good basis or explanation.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 11.

Wanted—A situation by an experienced foreman patternmaker. Box 82, Am. Machinist.

An experienced tool maker wishes to change situation. Address E. W., Am. Machinist.

Draftsman wanted; young man with some experience. Address B. F. Co., care Am. Machinist.

First-class machinist, familiar with building all kinds of steam engines, wishes position with opportunity to travel. Box 84, Am. Machinist.

Wanted—Situation as foreman boilermaker, by a man of experience on all kinds of boiler work; good references: age 33. R. W. O. Am. Machinist.

Wanted—Two or three first-class machinists familiar with wood-working machinery, to build our machines by contract. E & B. Holmes, Buffalo, N. Y.

Wanted—Position as foreman pattern maker; has charge of fifteen to twenty men; large shop preferred; wants to change. Box 83, Am. Machinist.

Wanted—At once, 2 or 3 competent draftsmen accustomed to locomotive work. State age, previous experience, and references. Brooks Locomotive Works, Dunkirk, N. Y.

A machinist of experience, any class of work wishes engagement where employment will be steady; good mathematician and draftsman. Address Experience. Am. Machinist.

Situation wanted as foreman boilermaker by a thorough mechanic who has been foreman a number of years, and can give reference as to ability, etc. Address J W. T., Am. Machinist.

Practical mechanic and manager wants charge of foundry and machine shop working 25 to 100 men, doing general work, millwrighting or manufacturing. Address Manufacturer, Am. Machinist.

Wanted Positon by young man, in some manufacturing line, or supply house; theoretical and practical in machinery; capable of doing general office work, traveling, etc. J. L. L., Am. Machinist.

Designer and draftsman, able to design a new line of first-class machine tools, drop hammers, hydraulic motors, hydraulic rams and specialties, desires engagement. Address H., Am. Machinist.

Wanted—At once, first-class machinists accustomed to high-speed engines; one lathe, one planer and two vise hands; good pay and steady work. Davenport Foundry and Machine Co., Davenport Iowa.

Two machinists want to change location on or before May 1; small town no objection; Middle or Western States preferred; correspondence solicited. Address Frank Jefferson, 546 E. 6th st., Erie, Pa.

Wanted—Head draftsman in machine shop, foundry and boiler works in Pennsylvania; graduate of technical school with experience preferred. Address, giving particulars, and stating salary expected, N. O. P., Am. Machinist.

Wanted—A practical mechanic to act as foreman in a factory stamping and forming of sheet metal and wire for small specialties; one that can make tools and dies; give age, experience, where employed last and wages expected, with references. Address Enterprise Manufacturing Co., Akron, Ohio.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent solid lubricant, clean, durable, cheap; prevents hot boxes. Crescent Mfg. Co., Cleveland.

The Crescent automatic grease cup is adapted to every service. Crescent Mfg. Co, Cleveland, Ohio.

Hard rubber blowing and pressing dies and machinery a specialty. E. O. Chase, Newark, N. J.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Wanted—Special machinery to build; correspondence invited. Address Drawer F, Shenandoah, Pa.

Estimates on light machinery and specialties—first-class facilities on machine shop and foundry Address the Novelty Iron Works, Passaic, N. J.

Steam users who desire to keep their boilers clear of scale at a cost of 10 cents a week, should read the card of the Pittsburgh Boiler Scale Resolvent Company on page 12. It will pay them.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer. Prepares designs of waterworks pumping stations, drawings of steam pumps, pumping engines, gen. mach'ry and pat. drawings.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

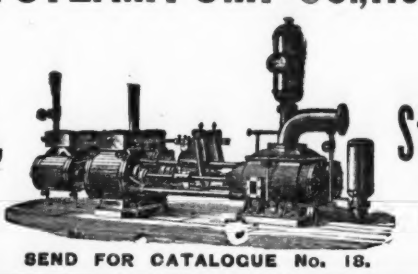
Bradley's HEATING FORGES

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

THE DEANE STEAM PUMP CO., Holyoke, Mass.

BUILD Water Works,  AND Steam Pumping ENGINES MACHINERY.

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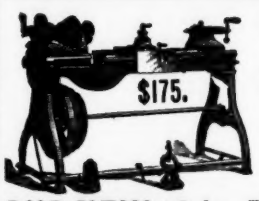

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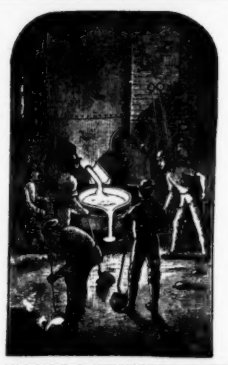

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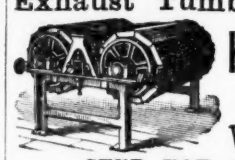

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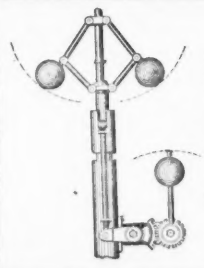

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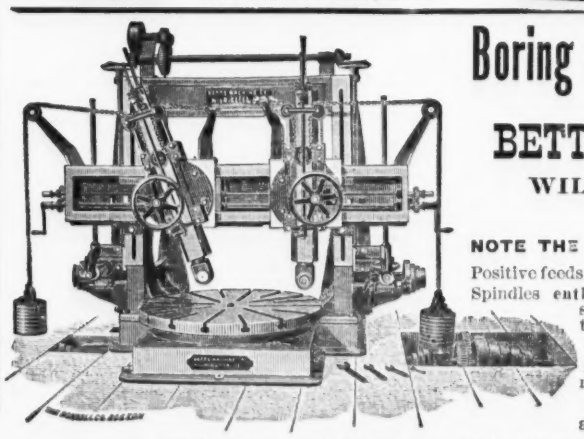

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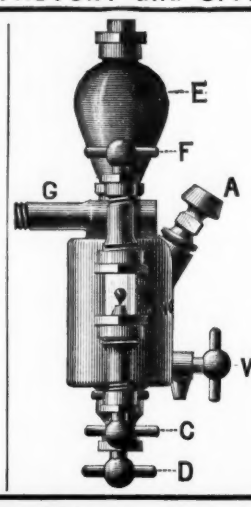

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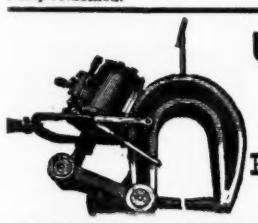

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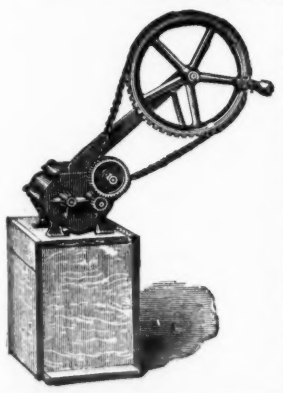

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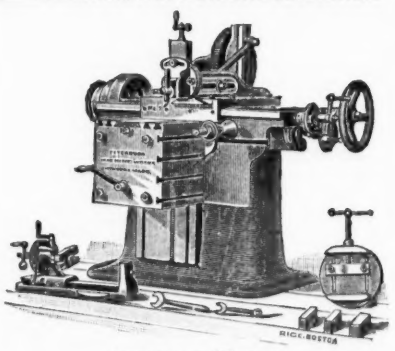

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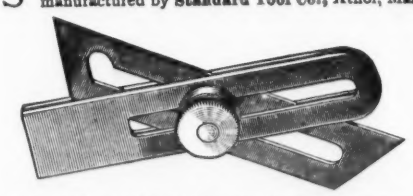

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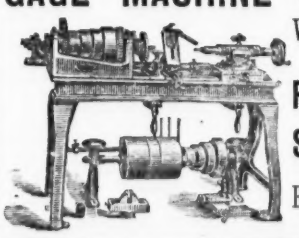

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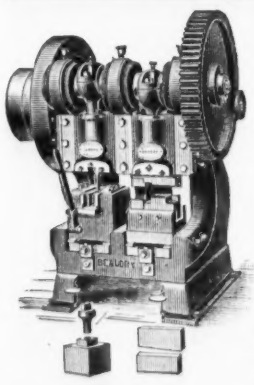

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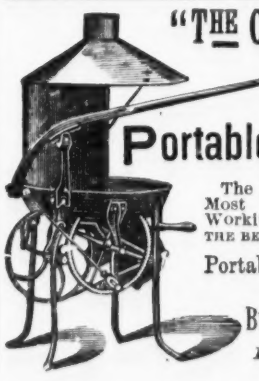

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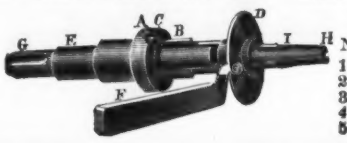

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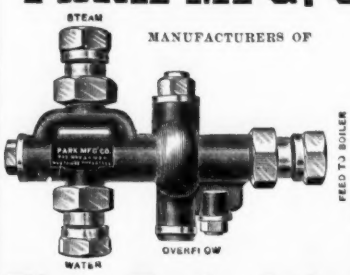

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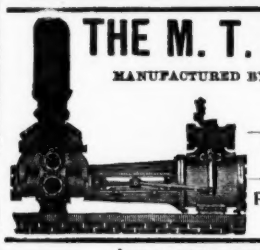

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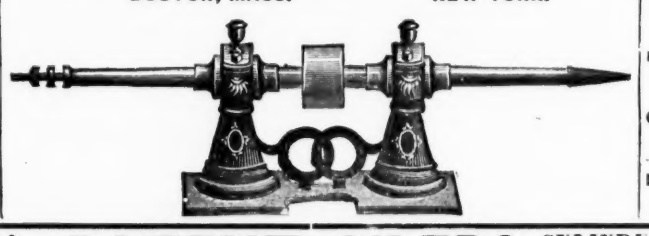

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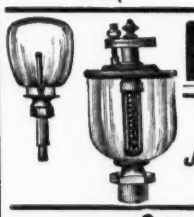

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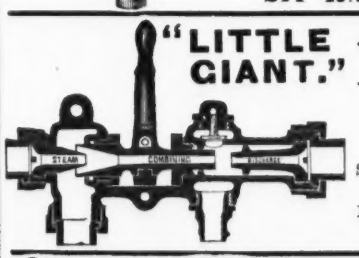

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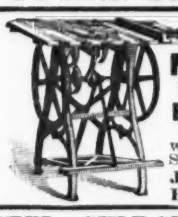

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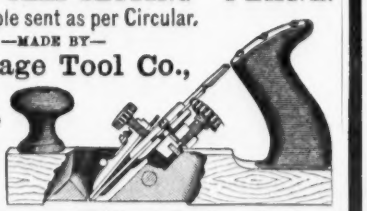

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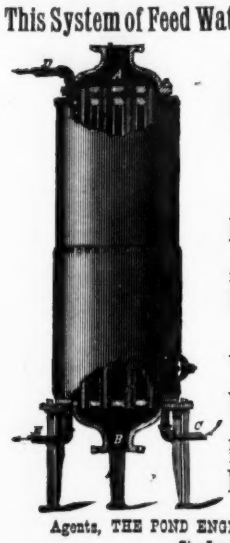

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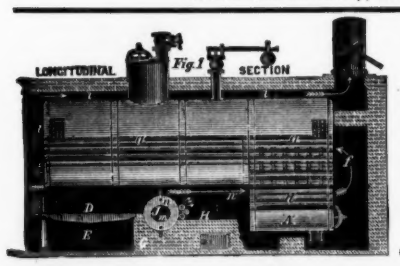

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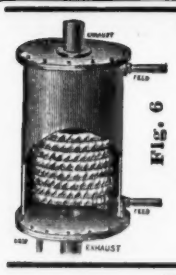

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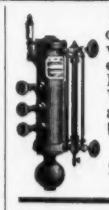

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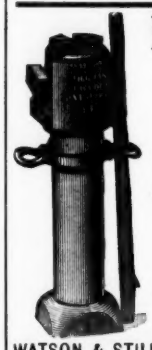

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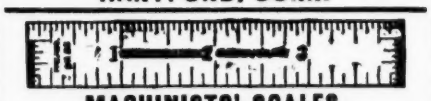

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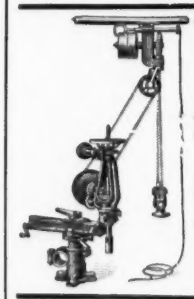

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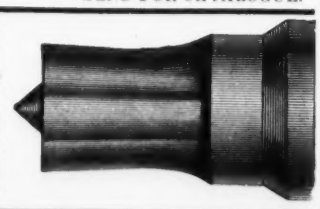

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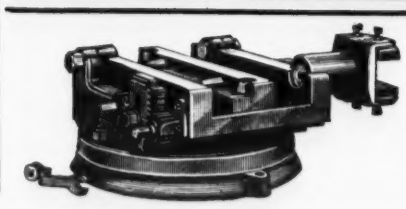

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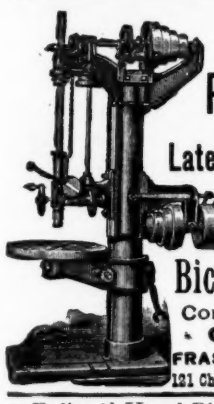

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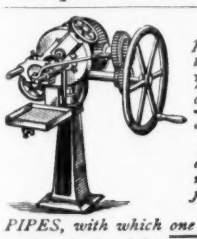

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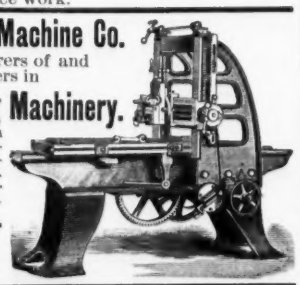

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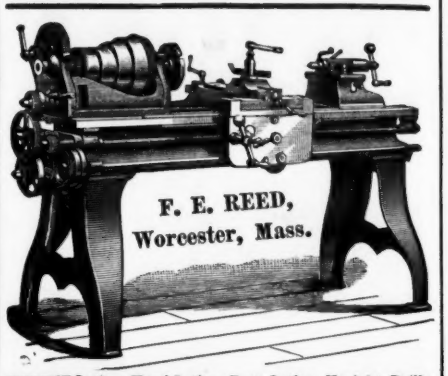

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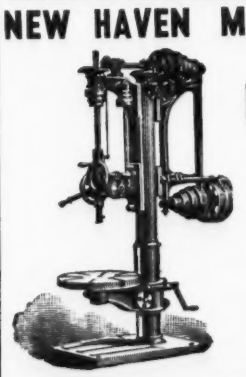

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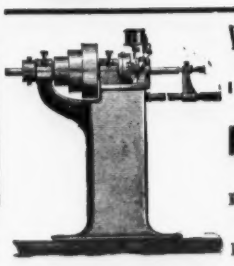

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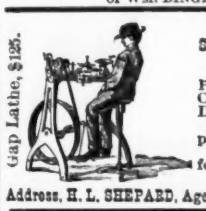

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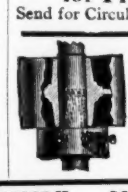

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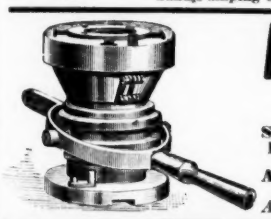

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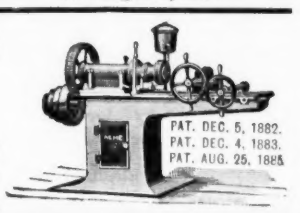

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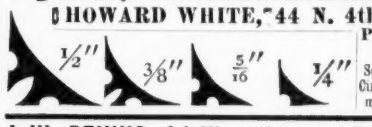

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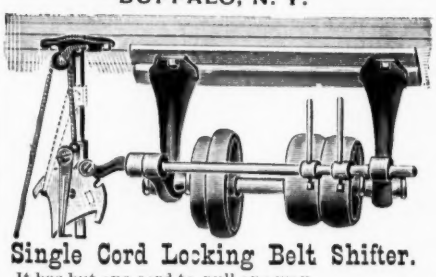

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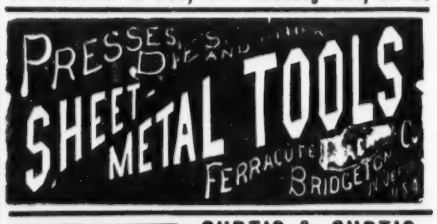

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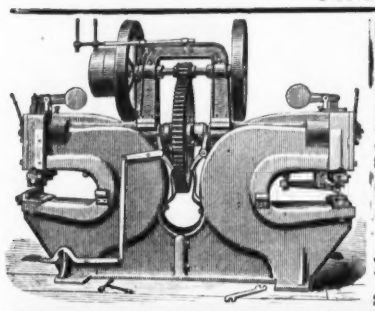

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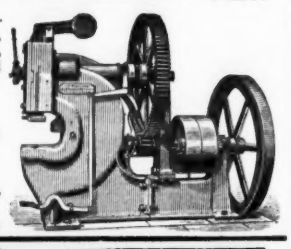

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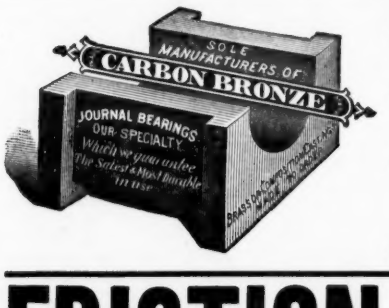

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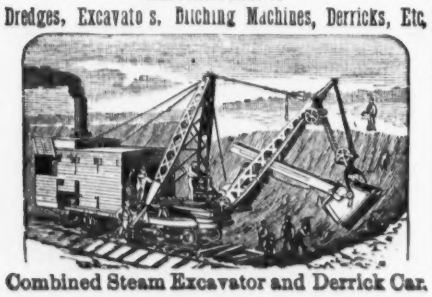

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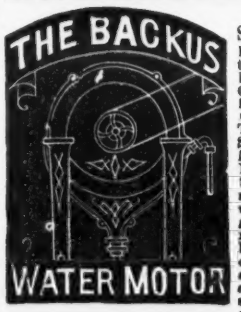

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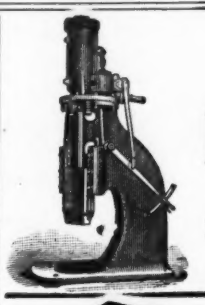

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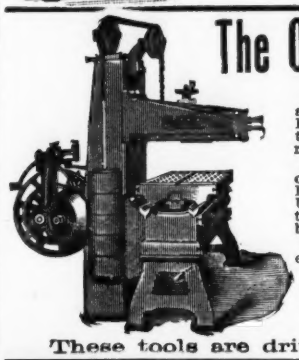

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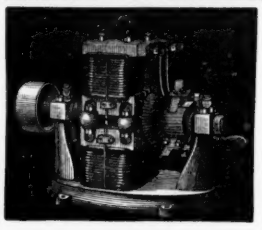

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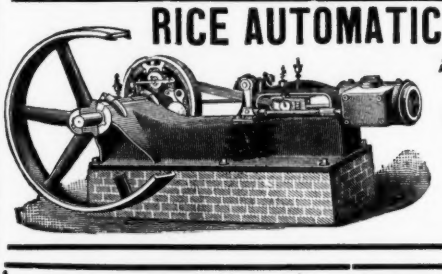

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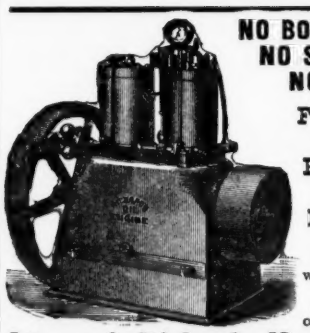

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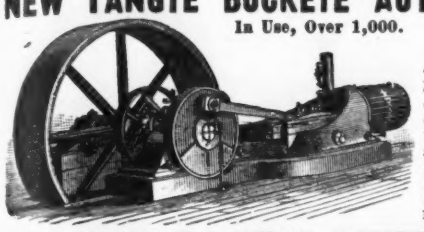

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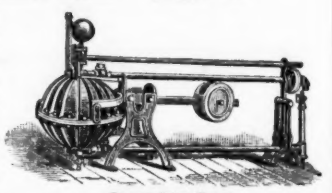

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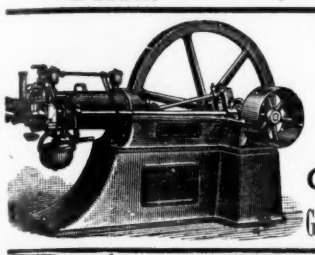

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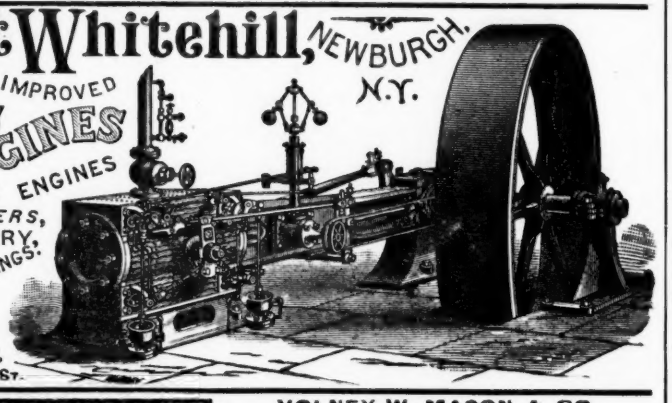

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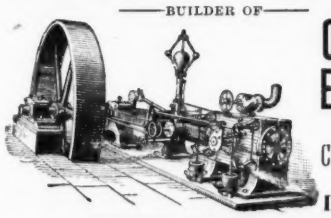

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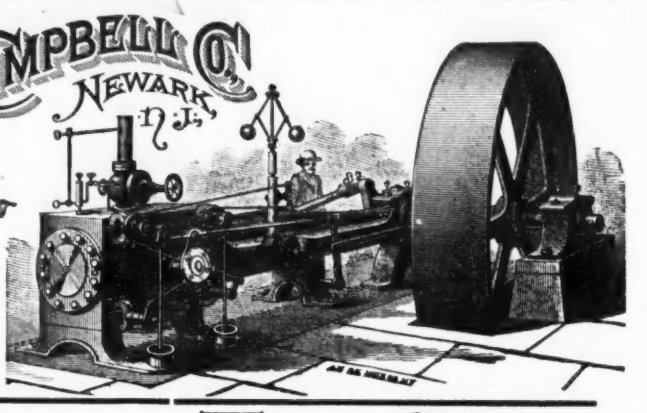

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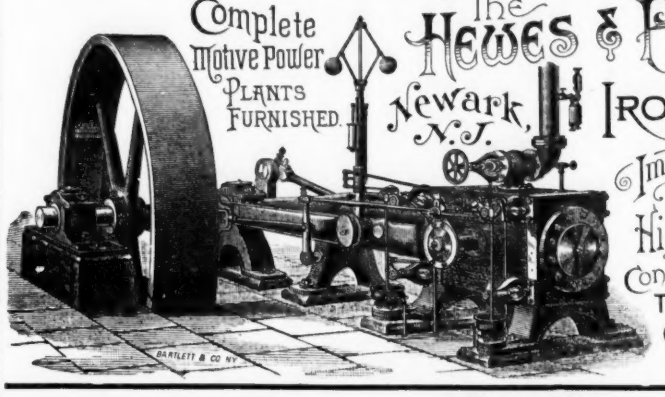

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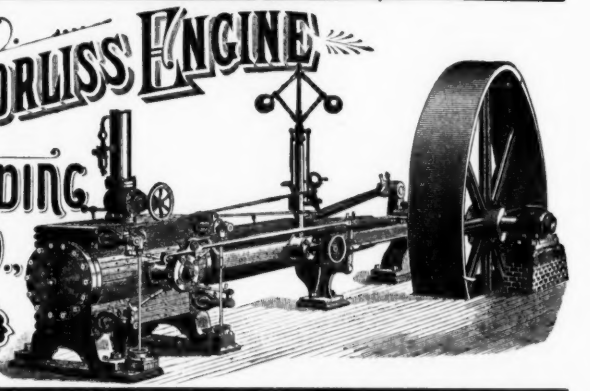

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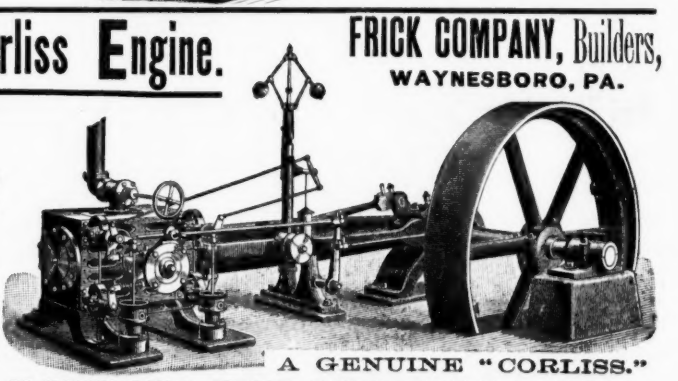

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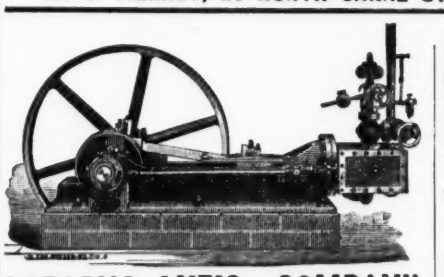

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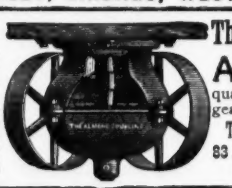

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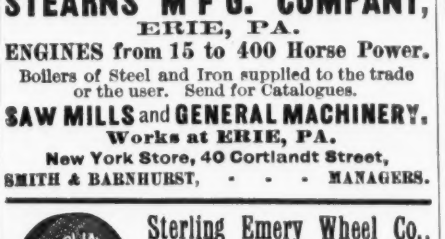

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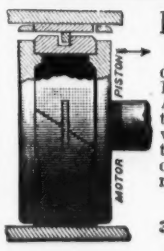

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12 "	5 "	"	Prentice Bros.
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15 "	6 "	"	"
14 "	6 "	"	Blaisdell.
1 "	6 "	"	"
16 "	8 "	"	"
24 "	14 "	"	"
17 "	8 "	"	Lathe & Morse
17 "	10 "	"	" "
19 "	8 "	"	" "
21 "	10 "	"	" "
27 "	16 "	"	" "
18 "	8 "	"	Flather.
20 "	10 "	"	"
18 "	8 "	"	Fifield
20 "	8 "	"	"
22 "	10 "	"	"
24 "	12 "	"	"
28 "	16 "	"	"
36 "	16 "	"	"
16 in. by	16 in. by	4 ft. Planer.	Hendey.
17 " "	17 " "	4 " "	Whit comb.
22 " "	22 " "	5 " "	"
24 " "	24 " "	6 " "	"
24 " "	24 " "	8 " "	Lathe & Morse.
2 " "	27 " "	7 " "	Whitcomb.
30 " "	30 " "	8 " "	"
36 " "	36 " "	10 " "	"
26 " "	26 " "	8 " "	Flather.
26 " "	26 " "	6 " "	Gleason.
30 " "	30 " "	9 " "	"
6 and 8 inch Stroke Shapers.			Boynton & Plummer.
15 and 24 inch "		"	Hendey.
20 " 25 "		" "	Eberhardt.
18 Inch Swing, Lever Drill.			Prentice Bros.
20 " "	Upright Drill.		" "
25 " "		" "	" "
30 " "		" "	" "
28 " "		" "	Blaisdell.
34 " "		" "	"

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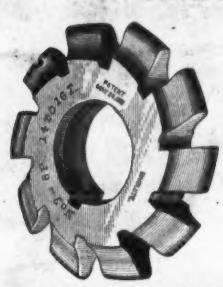
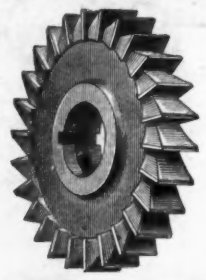
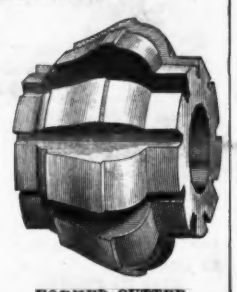


INVOLUTE GEAR CUTTER.



SIDE MILLING CUTTER.



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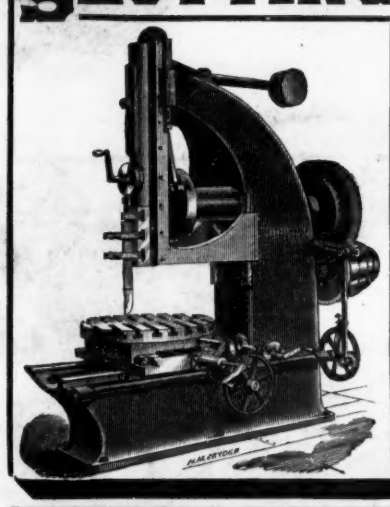

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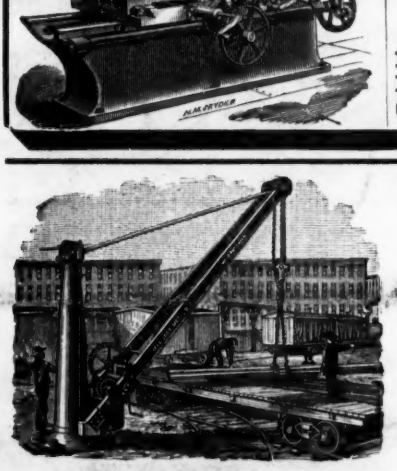

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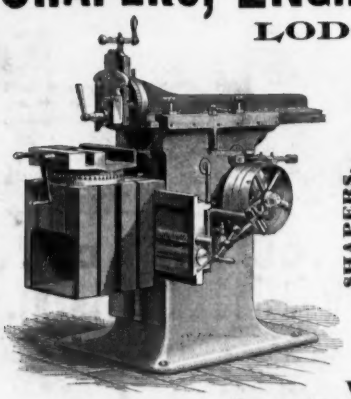

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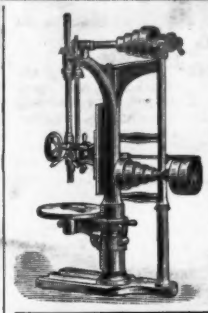

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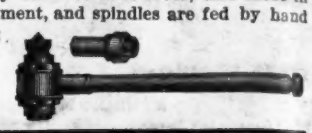

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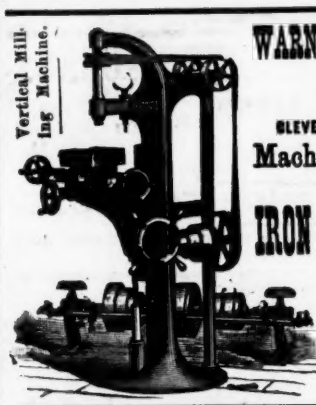

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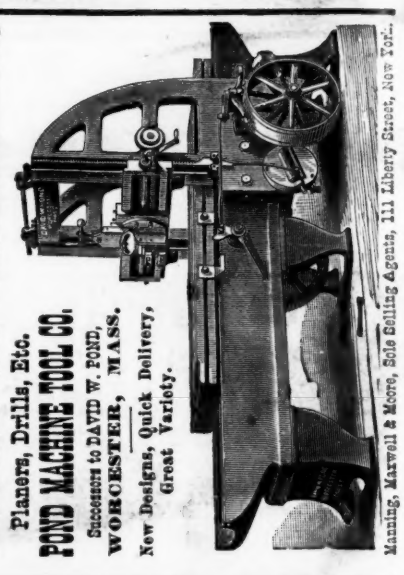

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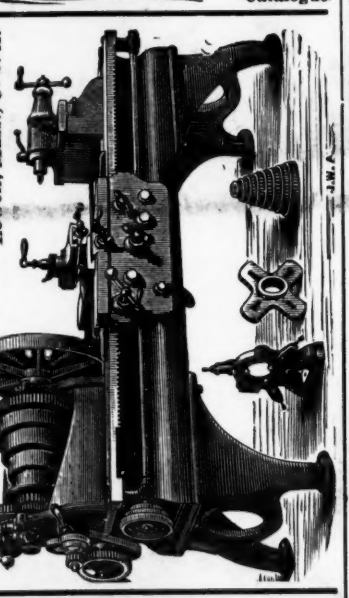

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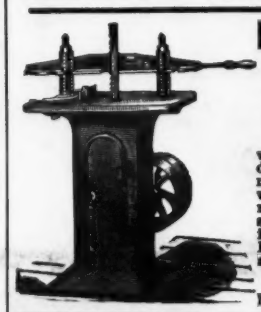

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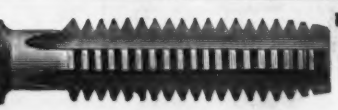

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